SRI G.V.G. VISALAKSHI COLLEGE FOR WOMEN
Autonomous & Affiliated to Bharathiar University
Accredited at A⁺ Grade by NAAC
Udumalpet – 642128, Tamil Nadu.

3.4.3 Details of research papers per teacher in CARE Journals notified on UGC website during the year: 44

Criteria 3 - Research, Innovations and Extension

S. No	Name of the Author(s)	Department of the Author(s)	Title of the Paper	Name of the Journal	Month and Year of publication	ISSN
1	Dr.K.Kaliammal	Economics	A Study on the Status of Sanitary Workers in Tiruppur District	KALA The Journal of Indian Art History Congress	2021	0975-7945
2	Dr.K.Kaliammal	Economics	Living and Working Environment of Sanitary Workers in Tiruppur District	Sambodhi	October - December 2020	2249-6661(P)
3	B.Geetha & Dr.K.Kaliammal	Economics	Inclinations In The Edifices Of Indian Sun Rise Industry –Food Processing	Juni Khyat	Aug-20	2278-4632
4	A.Poornima & Dr.K.Kaliammal	Economics	Solid Waste Management Practices in Palani	Utkal Historical Research Journal	February 2021	0976-2132
5	Dr.R.Rajini	Economics	Social Media Platforms Enhance the Business Opportunity for the Women Entrepreneurs	Wesleyan Journal of Research	March 2021	0975-1386
6	Dr.R.Rajini	Economics	Change in Life Style Behaviours During Covid 19	International Journal of Creative Research Thoughts	March 2021	2320-2882
7	Dr.S.Renukadevi	History	History of Telecommunication in India upto 2000	Infokara Research	July 2020	1021-9056
8	Dr.S.Renukadevi	History	Women's Health and Nutrition Special Reference to Tamilnadu	Strad Research	October 2020	0039-2049
9	Lt.Dr.P.Karpagavalli	History	Thagadur in Sangam Age	Flusser Studies (UGC Care Journal)	May 2021 -	1661-5719
10	Lt.Dr.P.Karpagavalli	History	Women's Activities towards family and Social Development	Journal of Emerging technologies and Innovative Research	July 2021	2349 - 5162
11	Lt.Dr.P.Karpagavalli	History	Udumalai Beerangi Vaara Idhal - A Research	Aran International e - Journal of Tamil Research	July 2021 -	282 - 399X
12	Dr.G.Karthiga	History	Welfare Schemes for Women Empowerment in Tamil Nadu	Infokara Research	July -2020	1021-9056
13	Dr.G.Karthiga	History	"Protection of Rightsof Women:- Global Scenario and Indian Context"	Strad Research	September 2020	0039-2049
14	Dr.B.Rajalakshmi	History	Evolution of Temples in Pandya country	AUT Research Journal	October 2020	0005-0601
15	Dr. S.Bhuvaneswari	Commerce(aided)	Functioning of public distribution system in covid 19 period	International Journal of advanced Research(IJAR) -	Aug-20	2320-5407
16	Dr. S.Bhuvaneswari	commerce(aided)	Investors opinion and level of satisfaction towards post office savings schemes	International Journal of Research and Analytical Reviews	Jul-20	2349-5138
17	Dr.K.Umamageswari &R.Beena(RS)	commerce(aided)	Awareness,Attitude and practices towards Pandemic Covid19 Among College Students in Udumalpet	Shodh Sanchar Bulletin	July-Sep 2020	2229-3620

3.4.3 Details of research papers per teacher in CARE Journals notified on UGC website during the year

Criteria 3 - Research, Innovations and Extension

18	Dr.C.Brindhadevi	commerce(aided)	Virtual learning in higher education in covid-19	National Journal on Social Issues & Problems-	Jul-20	2278-3199
19	Dr.M.Rajapriya	commerce(aided)	An Overview of Government Schemes for the Start-ups in Travel and Tourism	Mukt Shabd Journal	Jan-21	2347-3150
20	Dr.M.Rajapriya	commerce(aided)	A Study on Satisfaction Level of Coir Manufacturers in Pollachi, Coimbatore District	Dogo Rangsang Research Journal	Apr-21	2347-7180
21	Dr.R.Angel Joy, Dr.A.Kalavathi	Mathematics	Epiregularity in generalized topological space	Malaya Journal of Matematik,	Feb-21	2319-3786 (Print); 2321-5666 (Online)
22	P.Padmavathi	Mathematics	On Nano Generalized pre c-continuous functions in Nano Topological Spaces	Advances in Mathematics: Scientific Journal,	Sep-20	1857-8365
23	P.Padmavathi	Mathematics	Elimination of Attributes in Chronic Kidney disease using basis in Nano Topology	International Journal of Innovative Science, Engineering and Technology,	Mar-21	2348-7968
24	Dr. P.Jayalakshmi	Mathematics	Fuzzy Walk And Its Distance On Fuzzy Graph	Advances in Mathematics: Scientific Journal	Jul-20	1857-8365 (printed)
25	Dr. P.Jayalakshmi	Mathematics	Classification of states of random walk on fuzzy graph	Journal of Xiridian University,	Feb-21	1001-2004
26	Dr.V.Pankajam	Mathematics	$\alpha\omega I$ closed sets in ideal topological spaces	Journal of Xidian University,	Mar-21	1001-2004
27	Dr.M.Karpagadevi	Mathematics	A Note on αIg-Closure and αIg- Interior in Ideal Topological Spaces	Turkish Journal of Computer and Mathematics Education 1276-1279,	April -2021.	1309-4653
28	Dr.V.Pankajam	Mathematics	On generalized star $\omega\alpha I$ - closed sets in ideal topological star $\omega\alpha I$-spaces	Bulletin of Pure and Applied Sciences Section E – Math & Stat,	January-June 2021	0970-6577 (Print) 2320-3226 (Online)
29	Dr.A.Kalavathi	Mathematics	On the degenerate Elzaki transform	Bulletin of Pure and Applied Sciences Section E – Math & Stat,	January-June 2021	0970-6577 (Print) 2320-3226 (Online)
30	Dr.B.Kavitha and M.Nirmala	Physics	Fabrication of Dye Sensitized Solar Cell Based on Natural Photosensitizers	World Scientific News	Sep - 2020	2392-2192
31	Dr.B.Kavitha and M.Nirmala	Physics	Green Synthesis of Copper Nanoparticles Using Ocimum sanctum L. (Tulsi) and Piper nigrum L. (Pepper Seed) for Pollution Free Environment	World Scientific News	Oct - 2020	2392-2192
32	Dr.B.Kavitha and M.Nirmala	Physics	Synthesis and Characterization of SnO2 Nanoparticles by Co- Precipitation Method	International Journal of Nano Dimensions	Oct - 2021	2008-8868, 228-5059

Criteria 3 - Research, Innovations and Extension

33	Dr. J. Bhuvaneswari	Chemistry	Non-conventional photoactive transition metal complexes that mediated sensing and inhibition of amyloidogenic aggregates	Coordination Chemistry Reviews	Feb 2021	0010-8545
34	Mrs.V.Anitha	Chemistry	Imidazolatic-Framework Bimetal Electrocatalysts with a MixedValence Surface Anchored on an rGO Matrix for Oxygen Reduction, Water Splitting, and Dye Degradation	ACS Omega	June 2021	2470-1343
35	Dr.S.Beula Agnes	Zoology	Reviews on The Earthworm Powder Based Diet Of Eisenia Foetida Based Diet In The Aquaculture Production	Journal of Sambhodhi	October - December 2021	2249-6661
36	Dr.R.Sathya	B.Com SF	Performance Analysis of Health Insurance Companies in India	AB.Aadhar	Apr-21	2278-9308
37	Dr.R.Sathya	B.Com SF	A Study on Performance Analysis of Health Insurance Companies in India	A multidisciplinary & Multilingual Book on Innovative Best Practices in 21st Century(Opportunities & Challenges)	May-21	978-93-91305-02-4
38	Amirtham.PL	Management	A Revisit on Employee engagement	Aut Aut Research Journal	Aug-20	0005-0601
39	Amirtham.PL	Management	Retention factors as predictors of the job embeddedness	Mukt Shabd Journal	Dec-20	2347-3150
40	Mrs.R.D.Beulah	Mathematics(SF)	Distribution of Temperature on a Porous Fin Exposed to Uniform Magnetic Field to a Vertical Isothermal Surface by Homotopy Perturbation Method	Journal of seybold report	Sep-2020	1533-9211
41	K.Manimekalai	B.C.A	Deep Learning Methods in Classification of Myocardial Infarction by employing ECG Signals	Indian Journal of Science and Technology	Aug - 2020	0974-6846, 0974-5645
42	Mrs.R.D.Beulah	Mathematics(SF)	Regularity of Intuitionistic fuzzy hypergraphs	International Journal of Mathematics and its Application	Aug-20	2347-1557
43	R.D.Beulah	Mathematics (SF)	Recognizing emotions using elementary hyperedges in intuitionistic fuzzy soft hypergraphs	Bulletin of Pure and Applied Sciences Section E – Math & Stat, Volume 40E, Number 1, 108- 120	January-June 2021	0970-6577 (Print) 2320-3226 (Online)
44	P. Kavitha	Librarian	The Sconul Lenses: A Bird's Eye View	Emperor International Journal of Library and Information Technology Research	Jun 2021	2582-6972(O

Criteria 3 - Research, Innovations and Extension

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EDITOR-IN-CHIEF :

DR. MARUTHI NANDAN TIWARI

&

DR. KAMAL GIRI

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A STUDY ON THE STATUS OF SANITARY WORKERS IN TIRUPPUR DISTRICT

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ABSTRACT

The sanitary workers' own health and working conditions are often ignored by the people. Sanitary workers are often seen as the bottom level of the urban residents. They work in the situation of wind, cold and heat for a long term. They are affected by dust, poison, noise and other factors for long years. In addition, because of the traditional practice, sanitary workers are often considered to be of low birth, dirty in appearance and illiterate, by urban residents. Moreover, some persons call them "second-class citizens". Sanitary workers do not have a sense of belonging to the society. They are ill-treated and discriminated by birth and moreover, they struggle for social justice. At the bottom are the untouchables who are regarded as unclean, base and impure, a status which affects all their social relationships. They must be segregated from members of the caste system and live on the outskirts of villages or in their own settlements.

Keywords: Sanitary Workers, Scheduled Caste, Environmental Health, Urbanization.

INTRODUCTION

Environmental health cannot be ignored in social sustainable development. Sanitary workers are the "beautician of the city" has already contributed a lot to our construction of a harmonious society. Sanitary workers have played an important role in improving the urban and semi-urban ecological environment and the urban modern civilization, meeting the needs of people's desires for physical, spiritual, political, ecological civilization and implementing the social sustainable development. The name 'scavenger' was replaced by sanitary workers as the Government order was called from 1995. In Tamil Nadu after independence especially the government introduced change stating that all community people may join in this occupation. But those individuals from other communities engaged in sanitary work ask the Scheduled Caste instead people to work in these places and pay them an amount. Among the Scheduled Caste people who are engaged in the occupation like sweeping and scavenging and those who are bonded labours, tribes and nomadic tribes are classified as vulnerable groups. The sanitary workers' own health and working conditions are often ignored by the people. Sanitary workers are often seen as the bottom level of the urban residents. They work in the situation of wind, cold, heat and ram for a long term. They are affected by dust, poison, noise and other factors for long years. In addition, because of the traditional practice, sanitary workers are often considered to be of low birth, dirty in appearance and illiterate, by urban residents. Moreover, some persons call them "second-class citizens". Sanitary workers do not have a sense of belonging to the society. They are ill-treated and discriminated by birth and moreover, they struggle for social justice.

REVIEW OF LITERATURE

Anant Suchitra (1999) in her study about sanitary workers on economic Status and found that majority (90%) of the respondents were below the poverty line.

Borman (1999) pointed out that the sanitary worker's backwardness in education and income plays a major role in their economic conditions.

Singh (2000) in his study on dalit women in Uttar Pradesh highlighted the issues of socioeconomic conditions of scheduled caste female sweepers and scavengers in the municipal bodies of Uttar Pradesh. He lamented upon the poor status of scheduled castes females and recommended **rehabilitation** of Scheduled Caste female sweepers and scavengers in the state.

LIVING AND WORKING ENVIRONMENT OF SANITARY WORKERS IN TIRUPPUR DISTRICT

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Abstract

This paper tries to find the living and working environment of sanitary workers in Tiruppur district. The names of scavenging castes suggest that they are a functional community recruited from many different racial and social groups. It is very likely that people belonging to the lowest strata were compelled to take on this profession especially in the urban areas due to economic necessity. Hindu society in traditional India was divided into five main strata: four varnas, and the fifth group the outcaste, whose members were untouchables. Each caste is sub-divided into jati or sub-caste. Jati is an occupational group ranged in terms of ritual purity. The occupations of the first two varnas are clearly stated to be priesthood, administrative and military duties respectively. Below them the Vaishyas, in modern usage, were mainly merchants, and finally the Shudras were the producers. At the bottom are the untouchables who are regarded as unclean, base and impure, a status which affects all their social relationships. They must perform unclean and degrading tasks such as cleaning the human waste, urinals (toilet cleaning), disposal of dead animals, sweeping and scavenging. They must be segregated from members of the caste system and live on the outskirts of villages or in their own settlements. This article is purely based on the primary data. The collected data have been analyzed with the help of *ANOVA analysis.*

Keywords: Origin of scavenging, Sanitary workers, Percentage and regression analysis.

Introduction

The country, since its independence has made remarkable progress in almost all fields, which includes Green Revolution, White Revolution, Blue Revolution and information technology revolution, only to name a few and thereby improving the economic conditions of many segments of the population. However, there is one community which has largely remained untouched by such enviable progress is the community of municipal sanitary workers (SafaiKaramcharis). Totally cut-off from the mainstream of progress and immersed in ignorance and poverty, they are still subjected to the worst kind of oppression, discrimination and indignity and they are still treated as the lowliest of all. The names of scavenging castes suggest that they are a functional community recruited from many different racial and social groups. It is very likely that people belonging to the lowest strata were compelled to take on this profession especially in the urban areas due to economic necessity.

Hindu society in traditional India was divided into five main strata: four varnas, and the fifth group the outcaste, whose members were untouchables. Each caste is sub-divided into jati or sub-caste. Jati is an occupational group ranged in terms of ritual purity. The occupations of the first two varnas are clearly stated to be priesthood, administrative and military duties respectively. Below them the Vaishyas, in modern usage, were mainly merchants, and finally the Shudras were the producers. At the bottom are the untouchables who are regarded as unclean, base and impure, a status which affects all their social relationships. They must perform unclean and degrading tasks such as cleaning the human waste, urinals (toilet cleaning), disposal of dead animals, sweeping and scavenging. They must be segregated from members of the caste system and live on the outskirts of villages or in their own settlements.

The post-Vedic period witnessed the growth and consolidation of power due to the presence of hereditary groups in a hierarchy with Brahmins at the top and the untouchables at the bottom. These untouchables are called by different names such as "Harijans'(a glorified term, coined by Narsimha Mehta and adopted and popularised by Mahatma Gandhi) "Exterior Castes" (J.H. Hutton), "Depressed Classes" and "Dalit".

The Dalit, too, had traditional occupations but with a distant difference. By and large their occupations were least desirable and defiling (Srivastava, B.N. 1997). Apart from regional and local occupational variations the Dalit had mainly two main categories of profession, namely, leather processing and cleaning or sweeping. A caste working as remover of nightsoil and the cleaner of latrines belongs to a well defined group in the Indian social structure. All such workers in India are today covered under the general term "Scavenger". For this occupational group there are various names and titles in use in different parts of the country but the better known terms are 'The Mehtar' and its Mohammedan counterpart 'The Halalkhor'.

Cleaning or sweeping involved streets, drains and sewers; removal of human and animal excreta; raising of pigs, etc. Since toilets in most cities were not provided with flush, the scavengers had to carry buckets of human faeces on their heads. Their jobs are not only degrading, polluting and tedious, but they are also poorly paid. To eat the left-over of another person's plate is considered

highly degrading. It is a common practice among the scavengers to collect one or two chaatis from the houses they serve. Although this is a part of their customary rights and wages, it amounts almost to begging. This practice of collecting food is gradually disappearing from big cities, but it is still very much prevalent in small towns and villages.

Meaning and Definition of Scavengers

Literally, scavenging means cleaning up or removing filth, garbage, rubbish dirt, etc. A 'scavenger' therefore, is a person who is engaged or employed to clean, clear, collect, remove dispose or otherwise handle night-soil, filth, carcasses, garbage, rubbish, etc. Thus, interpreted, the word 'scavenger' should include in its sweep all sanitation workers even if they are employed at plush corporate offices as long as they functionally belong to this group. In fact, the definition of the term 'Scavenger, has led to considerable acrimony between the Ministry of Welfare, the nodal Ministry of Government of the India after the welfare of disadvantaged section of the society such as Scheduled Castes and tribes, people employed in unclean professions such as scavengers and flayesr, minorities, backward classes etc. and the National Commission for SafaiKaramcharis, a national level statutory Commission set up in August, 1994 under the provisions of National Commission for SafaiKaramcharis Act, 1993 (64 of 1993). Incidentally, the official Hindi word for the term 'scavenger' is 'SafaiKaramchari' which should, literally speaking, mean a sanitation worker. Unfortunately, the Hindi translation of the word scavenger has compounded, rather than abated, the prevailing confusion and disagreement over the interpretation of the word scavenger. Before its amendment in 1996, the National Schemes for Liberation and Rehabilitation of Scavengers and their Dependents, launched in 1992, defined 'scavenger' asunder:

"A scavenger is one who is partially or wholly engaged in the obnoxious and inhuman occupation of manually removing night soil and filth"

Now the Government of India has modified the definition of scavengers and it effected from 1st April 1996. The changed definition is as follows:

"One who is partially or wholly engaged in the oboxious and inhuman occupation of manually removing night-soil and filth"

The Hindi version of the printed text of the Scheme refers to scavengers as SafaiKaramacharis "SafaiKaramachari" has also been defined in clause (e) of Section 2 of the National Commission for SafaiKaramcharis Act, 1993 as follows:

"Safaikarmacharis means a person engaged in or employed for manually carrying human excreta or may sanitation work".

"That a section of humanity should be condemned to such degrading condition is a slur on our culture and a disgrace to our society". (A report of a committee of the National Labour Commission on the working and service conditions of sweepers and scavengers (1967-69).

A person employed to clean the street, seeks and collects discarded stems is an animal, a beetle, feeding on carrion refuse etc. (Encyclopedia Britannica, 1978).

That section humanity should be condemned to such degrading condition is a slur on our culture and disgrace to our society.

Origin of Scavenging

Ancient books do not mention any caste like the scavengers or removers of nightsoil among the traditional occupations nor do they mention any caste exclusively relegated to this profession. Even to this day scavenging as a profession does not exist in most of the rural areas.

The institutionalization of 'sweeping and scavenging' as a profession seems to be of recent origin. There is a reference in Kautilya's Arthashastra that during Maurya period defecation in an open space in the towns was prohibited but there is no mention about the disposal of nightoil by scavengers. The old scriptures, however, throw some light on the system of scavenging. Dr.Bindeshwar Pathak (1991) writes in his "Road to Freedom' that 'according to the contents of the scriptures and other literatures, scavenging, especially the disposal of nightsoil by a particular caste or castes of Indian society, has been in existence since the beginning of civilization with the emergence of towns. One of the fifteen duties for slaves enumerated in the Naradiya Samhita was to dispose of human excreta. In Vajasaneyi Samhita the Chandals and Paulkosa have been referred to as slaves for the disposal of nightsoil. Those who were made captives, were forced to clean latrines, bucket privies and throw off the nightsoil at distant places. These captives, when freed, were not accepted by the society and they formed a separate caste and continued the work of scavenging. During the British period with the setting up of army cantonments and municipalities, a large number of people were perhaps required to provide this service on a regular basis.

The names of scavenging castes suggest that they are a functional community recruited from many different racial and social groups. It is very likely that people belonging to the lowest strata were compelled to take on this profession especially in the urban areas due to economic necessity.

Stephen Fuchs (1981) has pointed out that "the endogamous sub-sections of this lowest of all low-castes, are not without a certain social gradation. Within the scavenging caste some sections are superior to others, and the social status is determined according to the origin of the section, claiming a former higher rank, or according to the type of work a particular section is doing. The lowest place is generally occupied by those sections which carry nightsoil. The highest sections have given up

scavenging entirely, and have adopted other occupations, such a leather work, weaving or farming. Among these lowest scavenging sections which remove nightsoil there is still a distinction; those who serve in private houses consider themselves higher than those who clean public latrines. It should not be forgotten that this type of work has to be carried out in urban environment and in villages where the women are not permitted to leave the house, even where it is for a call of nature. Each of these sub-sections has its own rules and regulations as to what work is permitted and where the line is to be drawn. Some do not touch nightsoil, but do all other scavenging work in the villages, including the removal of dead animals and garbage.

Problem that has Been Focused in the Study

Sanitary workers are at the very bottom of the socio-economic ladder of the society, whose condition is much worse than even that of the Scheduled Caste and Scheduled Tribe (SC and ST) in general. The nature of work they still carry out is not only inhuman and derogatory, but also quite condemnable. Many court rulings have been passed and many official measures and Acts have been implemented in order to not only promote the living conditions of the sanitary workers, but also to totally abolish the inhuman practices being carried out by them. But, even today, such practices are taking place in many states, railways and in other places. Modernization of the towns and city sewer systems has only changed the nature of work being done by the sanitary workers who are now forced to undertake the work of getting into the sewer pipes at the cost of their lives. Moreover, even their children are looked down upon by the society. The Centre for Human Rights and Social Justice noted that the children of manual scavengers are particularly vulnerable to discrimination in their schools, where they are forced to perform cleaning and scavenging work, and where discrimination undermines all aspects of their education and often causes them to drop out of school altogether . Also, after the introduction of economic reforms in the country, the process of contractualisation has also caught up with the sanitary workers, since most of them are employed on contract basis, losing even the benefits of permanent workers. In this background, it becomes quite necessary to examine the living and working environment of the municipal sanitary workers with the help of primary data, which is attempted in this study.

Objectives of the study

The following are the objectives of the study PMKVY

To assess the living and working environment of the sanitary workers

Research Methodology

Data Source

The data collected for the study is both primary one. The required data for the study were collected and compiled from various respondents from scavengers in Tiruppur district. In addition, other required data were collected from various magazines and journals.

Techniques of analysis

The collected data have been used for analysis with the help of statistical tools. The statistical tools namely ANOVA.

Sampling Design

The secondary data collected from scavengers in Tiruppur district. The primary data collected from structured interview schedule for the 400respondents.

Research Hypothesis

The following are the hypothesis has been framed in the presented study.

H_{01}: There is no significant relationship between personal factors of living and working environment of the sanitary workers.
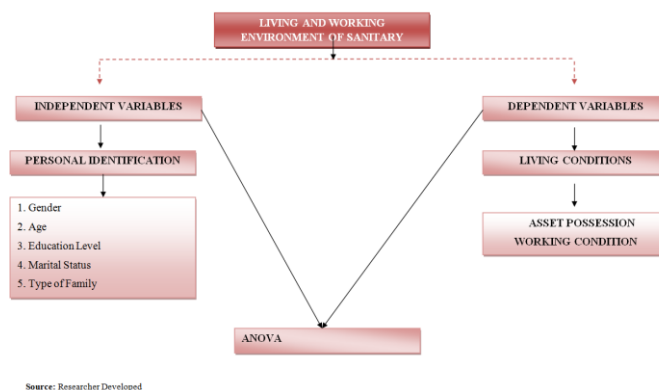
Model Derived From The Study

Source: Researcher Developed

Table – 1: The Age Influences the Assets Possession of Living Conditions in Sanitary Workers

H_{01} (a): There is no significant relationship between Age and Assets Possession of Sanitary Workers.

		Sum of Squares	df	Mean Square	F	Sig.
Radio/Transistor	Between Groups	17.098	2	8.549	7.053	**.001**
	Within Groups	481.212	397	1.212		
	Total	498.310	399			
Tape recorder	Between Groups	40.595	2	20.298	27.371	**.000**
	Within Groups	294.402	397	.742		
	Total	334.997	399			
Television	Between Groups	2.220	2	1.110	.960	.384
	Within Groups	459.078	397	1.156		
	Total	461.298	399			
Phone	Between Groups	21.861	2	10.931	18.698	**.000**
	Within Groups	232.076	397	.585		
	Total	253.938	399			
Bicycle	Between Groups	12.547	2	6.273	8.385	**.000**
	Within Groups	297.031	397	.748		
	Total	309.578	399			
Two wheeler	Between Groups	.006	2	.003	.008	.992
	Within Groups	140.704	397	.354		
	Total	140.710	399			
Fridge	Between Groups	.922	2	.461	.727	.484
	Within Groups	252.015	397	.635		
	Total	252.938	399			
Fan	Between Groups	11.660	2	5.830	10.946	**.000**
	Within Groups	211.450	397	.533		
	Total	223.110	399			
Mixer	Between Groups	23.346	2	11.673	16.751	**.000**
	Within Groups	276.654	397	.697		
	Total	300.000	399			
Grinder	Between Groups	9.734	2	4.867	6.196	**.002**
	Within Groups	311.864	397	.786		
	Total	321.598	399			
Gold jewels	Between Groups	.655	2	.328	.366	.694
	Within Groups	355.095	397	.894		
	Total	355.750	399			

Source: Primary Data

Table -1 depicts the ANOVA of personal factors and Assets Possession of Sanitary Workers during the study period. As far as age is concerned, the variables **Tape recorder, Phone, Bicycle, Fan, Mixer and Grinder** have the p-value which is less than the 5 per cent significance level. Hence, the hypothesis is rejected. That means that there is a significant relationship between personal factors and Assets Possession of Sanitary Workers. Rest of the variables is not significant at 5 per cent significance level. Hence, the hypothesis is accepted. That means that there is no significant relationship between personal factors and Assets Possession of Sanitary Workers.

Table – 2 The Education Level Influences the Assets Possession of Living Conditions in Sanitary Workers

H_{01} (c): There is no significant relationship between Education and Assets Possession of Sanitary Workers.

		Sum of Squares	df	Mean Square	F	Sig.
Radio/Transistor	Between Groups	.000	1	.000	.000	.992
	Within Groups	498.310	398	1.252		
	Total	498.310	399			
Tape recorder	Between Groups	.009	1	.009	.011	.918
	Within Groups	334.989	398	.842		
	Total	334.997	399			
Television	Between Groups	1.886	1	1.886	1.634	.202
	Within Groups	459.411	398	1.154		
	Total	461.297	399			
Phone	Between Groups	.047	1	.047	.074	.786
	Within Groups	253.891	398	.638		
	Total	253.937	399			
Bicycle	Between Groups	.041	1	.041	.053	.818
	Within Groups	309.536	398	.778		
	Total	309.577	399			
Two wheeler	Between Groups	.530	1	.530	1.504	.221
	Within Groups	140.180	398	.352		
	Total	140.710	399			
Fridge	Between Groups	2.227	1	2.227	3.535	.061
	Within Groups	250.711	398	.630		
	Total	252.937	399			
Fan	Between Groups	.191	1	.191	.341	.560

		Sum of Squares	df	Mean Square	F	Sig.
	Within Groups	222.919	398	.560		
	Total	223.110	399			
Mixer	Between Groups	.001	1	.001	.002	.967
	Within Groups	299.999	398	.754		
	Total	300.000	399			
Grinder	Between Groups	.350	1	.350	.434	.510
	Within Groups	321.247	398	.807		
	Total	321.597	399			
Gold jewels	Between Groups	.832	1	.832	.933	.335
	Within Groups	354.918	398	.892		
	Total	355.750	399			

Source: Primary Data

Table -2 shows the ANOVA of personal factors and Assets Possession of Sanitary Workers during the study period. As far as education level is concerned, the selected all variables have the p-value which is greater than the 5 per cent significance level. Hence, the hypothesis is accepted. That means that there is no significant relationship between personal factors and Assets Possession of Sanitary Workers.

Table – 3 The Marital Status Influences the Assets Possession of Living Conditions in Sanitary Workers

H_{01} **(d):** There is no significant relationship between Marital Status and Assets Possession of Sanitary Workers.

		Sum of Squares	df	Mean Square	F	Sig.
Radio/Transistor	Between Groups	12.565	3	4.188	3.414	.018
	Within Groups	485.745	396	1.227		
	Total	498.310	399			
Tape recorder	Between Groups	8.139	3	2.713	3.287	.021
	Within Groups	326.858	396	.825		
	Total	334.998	399			
Television	Between Groups	29.701	3	9.900	9.084	**.000**
	Within Groups	431.597	396	1.090		
	Total	461.297	399			
Phone	Between Groups	68.531	3	22.844	48.791	**.000**
	Within Groups	185.406	396	.468		
	Total	253.937	399			
Bicycle	Between Groups	1.167	3	.389	.499	.683
	Within Groups	308.411	396	.779		
	Total	309.578	399			
Two wheeler	Between Groups	.780	3	.260	.735	.531
	Within Groups	139.930	396	.353		
	Total	140.710	399			
Fridge	Between Groups	6.833	3	2.278	3.665	.013
	Within Groups	246.105	396	.621		
	Total	252.937	399			
Fan	Between Groups	9.821	3	3.274	6.078	**.000**
	Within Groups	213.289	396	.539		
	Total	223.110	399			
Mixer	Between Groups	52.918	3	17.639	28.271	**.000**
	Within Groups	247.082	396	.624		
	Total	300.000	399			
Grinder	Between Groups	.564	3	.188	.232	.874
	Within Groups	321.033	396	.811		
	Total	321.597	399			
Gold jewels	Between Groups	5.797	3	1.932	2.187	.089
	Within Groups	349.953	396	.884		
	Total	355.750	399			

Source: Primary Data

Table -3 depicts the ANOVA of personal factors and Assets Possession of Sanitary Workers during the study period. As far as marital status is concerned, the variables **Television, Phone, Fan and Mixer** have the p-value which is less than the 5 per cent significance level. Hence, the hypothesis is rejected. That means that there is a significant relationship between personal factors and Assets Possession of Sanitary Workers. Rest of the variables are not significant at 5 per cent significance level. Hence, the hypothesis is accepted. That means that there is no significant relationship between personal factors and Assets Possession of Sanitary Workers.

Table – 4 The Type of Family Influences the Assets Possession of Living Conditions in Sanitary Workers

H$_{01}$ (e): There is no significant relationship between Type of Family and Assets Possession of Sanitary Workers.

		Sum of Squares	Df	Mean Square	F	Sig.
Radio/Transistor	Between Groups	4.057	2	2.029	1.629	.197
	Within Groups	494.253	397	1.245		
	Total	498.310	399			
Tape recorder	Between Groups	2.997	2	1.499	1.792	.168
	Within Groups	332.000	397	.836		
	Total	334.997	399			
Television	Between Groups	20.929	2	10.465	9.434	**.000**
	Within Groups	440.368	397	1.109		
	Total	461.298	399			
Phone	Between Groups	14.999	2	7.499	12.460	**.000**
	Within Groups	238.939	397	.602		
	Total	253.937	399			
Bicycle	Between Groups	2.366	2	1.183	1.529	.218
	Within Groups	307.212	397	.774		
	Total	309.578	399			
Two wheeler	Between Groups	59.550	2	29.775	145.645	**.000**
	Within Groups	81.160	397	.204		
	Total	140.710	399			
Fridge	Between Groups	2.963	2	1.482	2.353	.096
	Within Groups	249.974	397	.630		
	Total	252.938	399			
Fan	Between Groups	4.452	2	2.226	4.041	.018
	Within Groups	218.658	397	.551		
	Total	223.110	399			
Mixer	Between Groups	25.057	2	12.529	18.090	**.000**
	Within Groups	274.943	397	.693		
	Total	300.000	399			
Grinder	Between Groups	23.752	2	11.876	15.829	**.000**
	Within Groups	297.846	397	.750		
	Total	321.597	399			
Gold jewels	Between Groups	63.158	2	31.579	42.847	**.000**
	Within Groups	292.592	397	.737		
	Total	355.750	399			

Source: Primary Data

Table – 4 shows the ANOVA of personal factors and Assets Possession of Sanitary Workers during the study period. As far as type of family is concerned, the variables **Television, Phone, Two-wheeler, Mixer and Grinder** have the p-value which is less than the 5 per cent significance level. Hence, the hypothesis is rejected. That means that there is a significant relationship between personal factors and Assets Possession of Sanitary Workers. Rest of the variables are not significant at 5 per cent significance level. Hence, the hypothesis is accepted. That means that there is no significant relationship between personal factors and Assets Possession of Sanitary Workers.

Table – 5 The Gender Influences the and Working Conditions of Sanitary Workers

H$_{02}$ (a): There is no significant relationship between Gender and Working Conditions of Sanitary Workers.

		Sum of Squares	df	Mean Square	F	Sig.
Nature of Employ	Between Groups	1.530	1	1.530	9.151	**.003**
	Within Groups	66.547	398	.167		
	Total	68.078	399			
W. Hrs	Between Groups	7.397	1	7.397	17.670	**.000**
	Within Groups	166.603	398	.419		
	Total	174.000	399			
Type of work	Between Groups	3.129	1	3.129	3.752	.053
	Within Groups	331.869	398	.834		
	Total	334.998	399			
Type of Equip.	Between Groups	2.369	1	2.369	3.069	.081
	Within Groups	307.209	398	.772		
	Total	309.577	399			
No. of yrs Experience	Between Groups	3.129	1	3.129	3.752	.053
	Within Groups	331.869	398	.834		
	Total	334.998	399			
Monthly Income	Between Groups	51.957	1	51.957	46.328	**.000**
	Within Groups	446.353	398	1.121		
	Total	498.310	399			
House hold Income	Between Groups	3.129	1	3.129	3.752	.053
	Within Groups	331.869	398	.834		
	Total	334.998	399			
Working Conditions	Between Groups	3.495	1	3.495	2.799	.095
	Within Groups	497.002	398	1.249		
	Total	500.497	399			

Source: Primary Data

Table - 5 shows the ANOVA of personal factors and Assets Possession of Sanitary Workers during the study period. As far as gender is concerned, the variables **Nature of Employ, working hours and Monthly Income** have the p-value which is less than the 5 per cent significance level. Hence, the hypothesis is rejected. That means that there is a significant relationship between personal factors and Assets Possession of Sanitary Workers. Rest of the variables is not significant at 5 per cent significance level. Hence, the hypothesis is accepted. That means that there is no significant relationship between personal factors and Working condition of Sanitary Workers.

Suggestions

The following suggestions are made on the basis of the analysis and information gathered from the respondents during field survey:

- Use of more machines and equipments should be encouraged in the activities carried out by the sanitary workers and proper replacement for their work need to be implemented. This will help avoid the workers to enter the sewers and indulge in manual scavenging, risking their lives;

- Governments should also come forward to provide comprehensive health insurance policy, with cashless treatment not only to the sanitary workers, but also for their dependents;

- There is an urgent need to improve the educational opportunities for the children of the sanitary workers, since they are not able the benefit from the existing system of education. This will provide them enormous confidence to seek employment elsewhere;

Conclusion

This study examined the living and working environment of the municipal workers who are employed in the municipalities of Tiruppur district, Tamil Nadu. This study brings out the problems faced by the sanitary workers and the difficulties faced by them in a holistic manner, between the contract workers and permanent workers. While the living and working conditions of a sanitary worker in general are quite poor, that of the contract workers is much worse. They are given only consolidated wage, which is quite low and are not given any allowances or sufficient holidays. Provision of safety gears is also very inadequate, which puts their life under severe risk.

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INCLINATIONS IN THE EDIFICES OF INDIAN SUN RISE INDUSTRY –FOOD PROCESSING

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Abstract

India is one of the key food producers in the world. India's Food Processing industry is one of the largest industries in the country - it is ranked fifth in terms of production, consumption, export and expected growth. Performance of food processing industry needs to be studied with the objective of understand the trends in the structure of Indian food processing industry. Period is confined to 13 years from 2004-05 to 2016-2017. Data collected from PROWESS created by CMIE. 16 companies have been selected for this study which consist four companies from Dairy sector, two companies from Grain milling sector, two companies from Meat and Poultry sector and eight companies from Consumer goods sector. In this research, Mean, Standard deviation, Co-efficient of variation, Annual growth rate and 't' test were employed Out of these **Dairy sector has the** *highest mean - GlaxoSmithKline Consumer Healthcare Limited in terms of six variables Net sales, Net profit, Total assets, Output, Labour and Capital.*

INTRODUCTION

India is one of the key food producers in the world, with the second largest arable land area. It is the largest producer of milk, pulses, sugarcane and tea in the world and the second largest producer of wheat, rice, fruits and vegetables. India's Food Processing industry is one of the largest industries in the country - it is ranked fifth in terms of production, consumption, export and expected growth. Food Processing is referred any technique or method that changes raw plant or animal material into safe, edible and more palatable food.

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IMPORTANCE OF PROCESSING OF FOOD AND FOOD PROCESSING INDUSTRY[1]

Food has been processed and packaged since the earliest days of man's history on earth. Meat and fish were salted, smoked and dried. Herbs were dried and stored for use as medicines. While most people in the world still rely on traditional foods for their basic diet those in industrialized Centre's tend more and more to purchase processed and packaged foodstuffs for convenience. The increasing number of women who now work away from home adds additional pressure for such changes. Even people with a heavily traditional diet are demanding external products either as occasional treats, such as gassy drinks or basic commodities such as white sugar and flour. To meet these demands the industrial food processing sector has emerged. Food and crop processing is generally considered to be the largest industry in most of the countries. Most of the studies revealed that in several developing countries have shown that up to 25 per cent of the urban population can be involved in making or selling ready-to-eat meals.

[2]Right from the cultivation and harvest of crop, up to the consumption of product by consumer, there is certain degree of value addition in every product. These activities not makes product attractive, more usable, gives choice and awareness to customers and also enhances shelf life of products. Apart from this, service rendered by intermediaries to pass on product from producer to customer is also valuable.

Food processing not merely adds value to the agro products, but also increases their utility. It is a known fact that activities in an economy are broadly classified into Agriculture, Industry and Services. Food Processing Industry is the part and parcel of agriculture and industry.

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[1]http://collections.infocollections.org/ukedu/uk/d/Jto01ae/3.1.html

[2]http://www.insightsonindia.com/2014/11/22/food-processing-industry-concepts-issues-scenario-india-world/

TYPES AND FUNCTIONS OF FOOD PROCESSING

Types of Food Processing

Food processing encompasses all the steps that food goes through from the time it is harvested to the time it arrives on consumer's plate. According to FAO (Food and Agriculture Organization), processed foods can be classified into three types viz. Primary, Secondary and Tertiary.

- The **primary processing** includes basic cleaning, grading and packaging as in case of fruits and vegetables.

- **Secondary processing** includes alteration of the basic product to a stage just before the final preparation as in case of milling of paddy to rice.

- **Tertiary** pro**cessing** leads to a high value-added ready-to eat food like bakery products, instant foods, health drinks, etc.

GLOBAL FOOD PROCESSING INDUSTRY

The global processed food industry is estimated to be valued around USD 3.4 trillion and accounts for three-fourth of the global food sales. However, only 6 percent of processed foods are traded across borders compared to 16 percent of major bulk agricultural commodities. The United States and European Union together account for over 60 percent of total retail processed food sales in the world. Trade liberalization policies through multi-lateral and regional trade agreements have led to a rapid growth in food processing. In the Asian region, Japan is the largest food processing market, but India and China are likely to grow at a faster rate in the next decade.

STRUCTURE AND COMPOSITION OF INDIAN FOOD PROCESSING INDUSTRY [3]

Food processing is a large sector that covers activities such as agriculture, horticulture, plantation, animal husbandry and fisheries. It also includes other industries that use agriculture inputs for manufacturing of edible products. The Ministry of Food Processing Industry, Government of India has defined the following segments within the Food Processing Industry:

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[3]https://www.ibef.org/download/Food_Processing_270608.pdf

- Dairy, fruits & vegetable processing

- Grain processing

- Meat & poultry processing

- Fisheries

- Consumer goods including packaged foods, beverages and packaged drinking water.

While the industry is large in terms of size, it is still at a nascent stage in terms of development. Out of the country's total agriculture and food produce, only 2 per cent is processed. The highest share of processed food is in the Dairy sector, where 37 per cent of the total produce is processed, of which 15 per cent is processed by the organised sector.

Primary food processing like packaged fruits and vegetables, milk, milled flour and rice, tea, spices, etc. constitutes around 60 per cent of processed foods. It has a highly fragmented structure that includes thousands of rice-mills and hullers, flour mills, pulse mills and oil-seed mills, several thousands of bakeries, traditional food unit fruits, vegetable and spice processing units in comparatively unorganised sector. In comparison, the organised sector is relatively small, with around flour mills, fish processing units, fruits and vegetables processing units, meat processing units and numerous dairy processing units at state and district levels.

FOOD PROCESSING INDUSTRY IN INDIA[4]

As per an estimation of IBEF, India's current food processing industry is estimated at USD 130 Billion and expected to attract huge domestic and foreign investment. Some of the key factors which are likely to increase the demand for processed food and consequently the food processing industry in the coming years are

- India is a country of over 1.25 billion population. With rising middle class having a considerable disposable income, the domestic market offers 1.25 billion opportunities for the sector.

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[4]IBEF India Brand Equity Foundation. Food Processing, Market & Opportunities. *Report, Fastest growing free market democracy*, 1-25.

- India ranks first in the world in the production of milk, ghee, ginger, bananas, guavas, papayas and mangoes. Further, India ranks second in the world in the production of rice, wheat and several other vegetables & fruits. If the surplus production of cereals, fruits, vegetables, milk, fish, meat and poultry, etc are processed and marketed both inside and outside the country, there will be greater opportunities for the growth of the sector.

- Next to China, India is among the fastest growing economies in the world. The recent quantum jump in the ease of doing business ranking of the World Bank (from 130 to 100) indicates the conducive business climate in the country and it is expected to attract foreign investment into this sector.

NEED AND IMPORTANCE OF THE STUDY

The food processing industry is one of the largest industries in India; it has gained prominence in the recent years. This sector serves as a vital link between the agriculture and industrial segments of the economy. Since, it is one of the key industries in Indian economy. It contributes to Gross Domestic Product (GDP), significantly generates vast employment opportunities, it is the source of foreign exchange earnings, and it encourages a huge amount of Foreign Direct Investment (FDI). Contribution of food processing industry in economic development is significant. Hence, the performance of food processing industry needs to be addressed.

SCOPE OF THE STUDY

The key facts about the segments of food processing industries are that, India has the largest irrigated land in the World. India produces annually 400 million liters of milk (higher in the world), 86.6 million metric tonnes of fruits and 169.4 million metric tonnes of vegetables (second largest), 512.1 million livestock (largest), 265.04 million tonnes of food grain (third largest), 11.41 million tonnes of fish (second largest), 729.2 million poultry and 88.1 billion of eggs. The scenario of the food processing industry has changed drastically with improved technology and trade liberalization policies have generated great growth opportunities in the food processing industry. So, performance of food processing industry needs to be studied.

STATEMENT OF THE PROBLEM

There are some bottlenecks faced in production of food products by the food processing industry. Small and dispersed marketable surplus due to fragmented

holdings, low farm productivity, high seasonality, perishability and intermediation result in lack of distribution on supply and quality, and in turn, impede processing and exports. The food processing industry has a high concentration of unorganized segments, representing almost 75 per cent across all product categories. Thus, explaining the inefficiencies in the existing production system, ascribed to the debility of small regional players to invest in technology up gradation and diversify into alternate product categories. Despite conferring numerous incentives for establishing new processing units, proportionate results have not been achieved. At this juncture of this research, the following question were probed by the researcher.

What extent the growth of food processing industry in India has been recorded?

OBJECTIVES OF THE STUDY

The study deals the performance of the food processing industries in India.

The main objective is given below.

- To understand the trends in the structure of Indian food processing industry

LIMITATIONS OF THE STUDY

- The findings and inferences derived in the study are applicable only to the Indian Food Processing Industry for the specific period.

- This study has selected 16 companies on the basis of sales turnover with above 1000 crores on an average. So, the other companies did not considered for this study.

- The nature of ownership was not classified as private, public or foreign.

- The study is based on secondary data, it has its own limitations.

REVIEW OF LITERATURE

Though many literatures are available in these areas, only a few important related works are considered and reviewed here.

Pramod Kumar, (2010)[5] sought in the research to assess the growth and perspectives of the Indian food processing sector. The objectives of this study were to

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[5] Pramod Kumar, (2010). Structure and performance of food processing industry in India. *Journal of Indian school of political economy.* 127-163.

compare the growth of the food processing industry vis-a-vis all industry, to identify among the 15 sub groups of the food processing industry the best performing and to measure the impact of growth on employment and creation of net value added (NVA). The period of study was 1989 to 2008. In order to understand the structure and performance of food processing industry various structural and financial ratios were computed and compared such as Working capital, Invested capital, Short term capital, Gross Value Added, Net value added, Net income, Profits, Distribution of NVA and Profit rate. It was found based on the growth performance two groups of food processing industry were identified like traditional and emerging sectors. It was concluded that the food processing industry had a strong potential in India.

Ruhul Salim and Kalirajan, (1999)[6] examined that the sources of output growth in Bangladesh food processing industries during both the pre-reform and the post-reform periods by decomposing output growth. The sample data for this research was taken from the Census of Manufacturing Industries (CMI) conducted yearly by the Bangladesh Bureau of Statistics (BBS). For this purpose, firm-level cross-section data was investigated in 3 individual years, viz., 1981, 1987 and 1991. They performed Minimum, Maximum and Mean analysis for this study. The results revealed the input growth contributed significantly to output growth in almost all the industries, although TFP growth improved from the early to late 1980s and in many industries input used increased approximately at the same rates as output growth. The results concluded that there was a substantial unrealized productive capacity in the Bangladesh food manufacturing sector which could be eliminated.

Among the different Industries of reviews, no one reviews does not handle the food processing industry in India with continuous 13 years of data from 2005 to 2017 and above 1000 crores sales turnover companies. So, the present study attempts to fill the existing gap.

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6   Ruhul A Salim, & Kalirajan, K.P. (1999). Sources of output growth in Bangladesh food processing industries: A decomposition analysis. *The Developing Economies, XXXVII*-3, 355–74.

RESEARCH METHODOLOGY

The methodology relating to the current study entitled *"Inclinations in Edifices of Indian Sun Rise Industry – Food Processing" is* examined under the following headings.

- Period of the Study
- Selection of the Sample
- Tools of Analysis

PERIOD OF STUDY

- Study period is confined to 13 years from 2004-05 to 2016-2017.
- Data collected from PROWESS created by CMIE (Centre for Monitoring Indian Economy).

2004-05 was the base year for WPI; it indicates that it is the normal year where normal economic activities were taken place. So from 2004-05 to 2016-2017 were taken into considerations.

SELECTION OF THE SAMPLE

- Food processing industry has been categorized into five heads such as Dairy, Grain milling, Marine, Meat & Poultry and Consumer goods.
- Based on the availability of data, 142 companies were shortlisted from 1499 companies.
- Criteria that the companies which have continuous 13 years of data and above Rs.1000 crores sales on an average have been determined.
- If sales value is too small, the value will be overestimated and the results could not be effective. In order to get correct inferences, the criteria have been fixed.
- 16 companies have been selected for this study which consist four companies from Dairy sector, two companies from Grain milling sector, two companies from Meat and Poultry sector and eight companies from Consumer goods sector.
- With regard to the Marine sector, no company fulfilled the criteria so it is exempted from the sample.

FRAME WORK OF ANALYSIS

In this research, Sample Company has taken 16 companies in food processing industry in India. For examining the growth of the food processing companies, the variables like net sales, net profit, total assets, output, labour and capital have been considered. The 13 years data of the four sector companies were taken for this research. In this research, Mean, Standard deviation, Co-efficient of variation, Annual growth rate and 't' test were employed.

CONCEPTS

i) Output

Value added reported in CMIE does not allow for non-industrial costs. So contribution to GDP as output which equals value of production minus industrial cost minus net non-industrial cost.

ii) Capital

Capital consists of land and building, plant and machinery and other fixed assets which are expected to have a productive life of more than one year and are in use by the establishment for the manufacturing activity.

iii) Labour

Labour includes employees, working proprietors, unpaid family workers and home workers.

TRENDS IN THE STRUCTURE OF INDIAN FOOD PROCESSING INDUSTRY

For examining the trends of the food processing industry, the variables like net sales, net profit, total assets, output, labour and capital have been considered. Past 13 years data were used and descriptive analysis was made. Further, growth rate has been identified through annual growth rate and significance also was examined through 't' test.

INCLINATIONS IN THE EDIFICES OF INDIAN FOOD PROCESSING INDUSTRY:

Variable	Tools	Dairy	Grain milling	Meat & Poultry	Consumer goods
Net Sales	**Mean**	GCHL	BIL	APL	NIL
	CV	GCHL	BIL	APL	NIL
	AGR	All companies	All companies	All companies	6/8
Net Profit	**Mean**	GCHL	BIL.	FCAL	NIL
	CV	GCHL	MIFL	FCAL	NIL
	AGR	All companies	1(2)	All companies	6/8
Total Assets	**Mean**	GCHL	MIFL	FCAL	CCIL
	CV	HFL	BIL	APL	DCM
	AGR	All companies	All companies	All companies	All companies
Output	**Mean**	GCHL	MIFL	FCAL	DCM
	CV	GCHL	MIFL	FCAL	CCIL
	AGR	All companies	All companies	All companies	6/8
Labour	**Mean**	GCHL	MIFL	FCAL	NIL
	CV	GCHL	BIL	FCAL	DCM
	AGR	All companies	All companies	All companies	7/8
Capital	**Mean**	HAPL	MIFL	FCAL	NIL
	CV	GCHL	BIL	FCAL	CCIL
	AGR	All companies	All companies	All companies	7/8

GCHL - Glaxosmithkline Consumer Healthcare Limited

HFL   - Heritage Foods Limited.

HAPL - Hatsun Agro Products Limited.

BIL   - Britannia Industries Limited.

MIFL - Mondelez India Foods Pvt. Limited.

APL   - Allanasons Pvt. Limited.

FCAL - Frigerio Conserva Allana Pvt. Limited.

NIL   - Nestle India Limited.

CCIL - Cotton Corporation of India Limited.

DCM - D CM Shriram Industries Limited.

The trends of Indian food processing industry, the research has taken with the variables net sales, net profit, total assets, output, labour and capital. In the case of **Net Sales**, the company Kwality Limited has recorded *high growth* in Dairy sector, Mondelez India Foods Private Limited in Grain Milling sector, Frogerio Conserva Allana Private Limited in Meat & Poultry sector, Varun Beverages Limited in consumer goods sector. The companies Kwality Limited in Dairy sector, Britannia industries Limited in Grain Milling sector, Allanasons Private Limited in Meat & Poultry sector and Hindustan Gum & Chemicals Limited in Consumer Goods sector have recorded high growth in its **Net Profit**. While considering **Total Assets** of the selected companies, the companies Kwality Limited in Dairy sector, Mondelez India Foods Private Limited in Grain Milling sector, Allanasons Private Limited in Mean & Poultry sector, Hindustan Gum & Chemicals Limited in consumer goods sector have found the highest growth during the study period. Output is one of the important variables for finding the performance of the selected companies and so the companies, Kwality Limited in Dairy sector, In the case of **output**, the companies Kwality Limited in Dairy sector, Britannia industries Limited in Grain Milling sector, Frogerio Conserva Allana Private Limited in Meat & Poultry sector, Varun Beverages Limited in Consumer Goods sector have registered the highest growth during the study period. The companies Kwality Limited in Dairy sector, the company Mondelez India Foods Private Limited in Grain Milling sector, Allanasons Private Limited in Meat & Poultry sector and Varun Beverages Limited in Consumer Goods sector has accounted the highest growth rate during the period of the study in **Labour** variable. The variable capital has found the highest growth from the companies Kwality Limited in Dairy sector, the company Mondelez India Foods Private Limited in Grain Milling sector, Allanasons Private Limited in Meat & Poultry sector and Varun Beverages Limited in Consumer Goods sector.

Also it is revealed that in Dairy sector, *highest mean* value was recorded in GlaxoSmithkline Consumer Health care Limited in terms of Net sales, Net profit, Total assets, Output, and Labour. In Grain milling sector, Britannia Industries Limited has the highest mean value in terms of net sales and net profit, Mondelez India Foods Private Limited has the highest mean value in terms of total assets, output, labour and capital. In Meat and Poultry sector, Frigerio Conserva Allana Private Limited has recorded the highest mean value in net profit, output, labour and capital; Allanasons Private Limited has recorded highest mean value in net sales and total assets.   In Consumer

goods sector, Nestle India Limited has realized the highest mean value in terms of net sales, net profit, Labout, and Capital and total assets was realized by Cotton Corporation of India Limited, output was realized by DCM Shriram India Limited.

In terms of **co-efficient of variation,** GlaxoSmithKline Consumer Health care Limited has more stable in terms of net sales, net profit, output, labour and capital in Dairy sector. In Grain milling sector, Britannia Industries limited, has more homogeneous in net sales, total assets, labour and capital and Mondelez India Foods Private Limited has more homogeneous in net profit and output. Frigerio conserva Allana private Limited has more consistent in terms of net profit, total assets output, labour and capital and Allana sons private limited has more consistent with net sales in Meat and Poultry sector. In Consumer goods, DCM Shriram Industries Limited has more stable in net sales, total assets and labour, Nestle in net profit, Cotton Corporation of India Limited in terms of output and capital.

Thus companies have shown mixed trend.

RECOMMENDATIONS

Collaborations, joint venture, attracting foreign direct investment, fiscal incentives etc. are various ways to tap this potential. There is urgent need for training and retaining the labour for skilled job profile to strengthen the Food Industry. Hence there is a potential to increase the output of the food processing sector with the existing resources.

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SOLID WASTE MANAGEMENT PRACICES IN PALANI

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Abstract

Palani is identified by Hill Muruga Temple. It is an important religious tourist place and ears more revenue. Maintaining green environment is an essential component. In this place mass floating population is the significant feature, it generates huge wastes; managing solid waste t is a first prioritized task. Clean and hygieneenvironment is the responsible for concern Municipal Corporation. So temple and health care units are taken into consideration.

In this study we can have a detail of, how the wastages from temples and healthcare services are managed, and what are all improvements needed in its process, and then how should be environmental safety procedures implemented. **Specific objectives** of this study areexamining solid waste management of health care units and study solid waste management of temple. This study is based on primary data, interview schedule were used to collect the data from Hospitals and municipality and panchamritham making madabams. Only 7 madabams are taken into consideration which is under Palani devasthanam. Primary data was collected by administering as pre-tested interview schedule.Findings are highlighted as temple wastes are recycled and make it as fertilizers, this may be purchased by farmers,Continuous working with wastes for long hour's results in several health problems for sanitary workers. All the workers should have medical insurance schemes for treatment and compulsory medical checkup is been done every month in the district medical hospital.

Keywords: green environment, Solid waste Management, Medical waste disposal, temple waste into products, medical waste hazards, medical waste segregation.

INTRODUCTION

Palani is one of the famous Pilgrim Centre.Since Palani is a tourist place by religion floating population is high during normal season as well as festival season.Solid waste is the major issues it is required to be concentrated. In this regard two important area should be taken into consideration, one is "Temples" and another one is "Healthcare Service". Every year the number of persons who visit Palani have been increasing continuously. In order to maintain the city clean and hygiene obviously wastages should be maintained properly. Hence this study focusses the Solid waste management practices followed in Temple and health care units.

WASTE FROM HEALTH CARE UNITS:

Waste caused by health care units which includes Clinic, Hospitals, laboratories, Bio – medical research Centre's etc.Health care units which produces mass wastes in terms of quantity as well as variety.

Improper way of disposal of health care wastes would create serious hazards of secondary disease transmission due to exposures to infectious among waste pickers, sanitary workers, health workers, patients, and the community in general where waste is improperly disposed.

Burning wastages in an open placeas well incineration without adequate pollution control exposes field workers who involved in that process and the surrounding to toxic contaminants in air emissions and ash.

RISKS

Healthcare waste can be categorized into - sharps waste, pathological waste, other infectious wastes,radioactive waste, pharmaceutical waste including cytotoxic waste, hazardous chemical waste and general (non-risk) waste.

In common, between 75% and 90% of the wastages produced by healthcare units is a non-risk (non-hazardous&non-infectious).Infectious waste is suspected to contain pathogens (disease-causing bacteria, viruses (Corona), parasites, or fungi) in sufficient concentration or quantity to cause disease in susceptible hosts.

TEMPLE WASTE:

Temples, churchesand mosques possess a characteristic of attracting positive and divine vibrations from the surroundings; they sanctify the area and are believed to charge the atmosphere with heavenly vibes among the people too. People are accustomed to offer lot of flowers, garlands, coconut and milk to the deities in the temples as they are considered a symbol of devotion and reverence.But think every year how much tons of temple waste are dumped into the rivers and how much natural resources are become garbage. Most of temple wastages are killing fishes and other living beings, creating chaos in the fragile atmosphere and thus causing water pollution. With these, pesticides and fertilizers alsostream in the river, threatening to the civic lives to a large magnitude.

Food, coconut scrub, flowers, cloths and leaf these kind of temple wastes can be used for many productive ways. Due to improper ways of disposing and handling method of wastages it become threaten to the living beings and environment too.

With this background this study has the objective of studying the solid waste management practices in Palani.

Specific objectives are

Examine solid waste management of health care units.
Study solid waste management of temple

NEED OF THE STUDY

Green environment is the need of the hour. To maintain green environment so many aspects to be considered like pollution control, plantation, avoid plastics, of which solid waste management is one of the focusing areas to maintain green environment. In this, four aspects are there, wastes from temple and health care units are notable area to study.

SCOPE OF THE STUDY

Palani comes under religious tourist place; because of this the rate of floating population is increasing throughout the year. It generates revenue to the government. Bring sustainable development in socio economic aspects; the solid waste management is an essential component. Hence solid waste management practices of health care unit and temple is to be studied.

METHODOLOGY

This study is based on primary data interview schedule were used to collect the data from municipality and panchamritham making madabams. Only 7 madabams are taken into consideration which is under Palani devasthanam. Banana wastes are handled by Municipal Corporation.

LIMITATIONS OF THE STUDY

1. Study focuses only on hospitals in health care services.
2. Hill temple only considered, other temples are excluded.
3. Study is based on primary data it has its own limitations.

REVIEW OF LITERATURE

Sineenart Puangmanee and Moltiya Jearanai E (2019) in their study **"Healthcare Waste Management: A Case Study of Health-Promoting Hospitals"** they examined the Healthcare waste management from health-promoting hospitals in some local areas of Thailand is weakly regulated. Environmental Pollution, that is originates from the poor management, ineffective control, and unsuitable disposal. We have reviewed the management of healthcare waste at health-promoting hospitals, aimed to study the type, quantity of healthcare waste, storage, collection, transportation and disposal. To the research, six hospitals were selected and prioritized from a district in a province in the upper part of southern Thailand. All waste was classified into two types as like waste from treated patients (general waste, hazardous and infectious waste) and waste from untreated patients (domestic and hazardous waste). The highest percentage of wastages from treated patients were 68.20% and waste from untreated patients were 86.60%. The waste from treated patients at all hospitals was put into red plastic bags/containers and placed inside stainless steel or plastic garbage cans. The waste materials were transferred daily by hospital employees. Wastages from the treated

patients were transported by a hospital employee who were unsuitable and non-protective equipment wearied persons. The waste materials were collected from all hospitals once in a week by pickup truck/lorry and moved to a single hospital point in the district where it waited for transportation to an incineration plant in central Thailand. The waste from untreated patients were transported by employees of the sub-district administrative organization. They also wore unsuitable protective equipment while working. The waste from untreated patients were transported by compact garbage truck and moved for disposal in two open dump sites in and around the local area. Although, the waste materials were basically managing by the guidelines, some of the handling processes were incorrect and ineffective. Therefore, everyone involved in healthcare waste managements and services from the top to down need to strictly practice the guidelines according to the laws for a better environment.

Mohammed Shafith. S(2018) stated the **"Hospital Waste Management and Environmental Problems in India",**analyzed that in the main purpose of this paper is to convey a browsing of the hospital waste management and environmental drawback in India. This study's target is to analysis the health care waste management system, as well as practices and compliances. Most countries of the planet, especially the developing countries, are facing the grim situation arising out of environmental pollution, because of pathological waste arising from increasing populations.And also the result ascent within the range of hospital units. In India, there are regarding 6,00,000 hospital beds, over 23,000 primary health centers, more than 15,000 small and personal hospitals. The biomedical Waste (Management and Handling) Rules 1998 build it obligatory for hospitals, clinics, and different medical and veterinary institutes to eliminate bio medical wastes consistent with the principlesstrictly. The few studies on bio medical waste management have established that hospitals did not manage health care waste properly.

Unsuitable disposal methods of health care waste causing dangerous infections and possessan attainable threat to the encircling surroundings, persons handling it and to the overall public. Within the past, medical wastageswere usually mixed with unit waste and disposed of in municipal solid waste landfills. In recent years, inflated public and environmental considerations over the improper disposal of health care waste have led to a movement to control the waste additional consistently and strictly by the Indian government. Waste reduction and utilization are still not well promoted and educated, which ends in vital amounts.

Isha Yadav et.al (2015) reported **"Temple Waste Utilization and Management: A Review"** evaluated that In India, worshiping is the way of living and people offer various offerings to the deities which are consisting of flowers, fruits, leaves, coconuts, clothes and others out of which floral offerings are found in huge quantity. Thus, temple waste has a unique share of flower waste in the total waste. After completing their purpose, flowers along with other wastages, find their way into the garbage or are discarded either into some of water bodies or left up on the open places or throwing everywhere as a waste causing various environmental problems. The majorly offering flowers in the temples are rose, marigold, jasmine, chrysanthemum, hyacinth, hibiscus and others,These floral wastes can be utilized in different ways of recycling like produce valuable products,this can help to save environment from pollution caused due to improper disposal of flower waste. Techniques like vermicomposting, composting, dyes extraction, making of holicolors, extraction of essential oils and bio-gas generation can be used. This flower wastes/garbage can also be used for making incense sticks besides using them for some art and craft techniques. Petals of different kind of flowers can also be utilized for handmade papers/papermaking by extracting the pulp or by mottling them into the readymade pulp. In this paper, we have reviewed the temple waste can be utilized and managed to get valuable products which will lead to a healthier and waste free environment pollution.

Mohankuma .S and Dr.K.Kottaiveeran (2011) reported the "Hospital Waste Management and Environmental Problems in India" they studied that the major purpose is to give a view of the "hospital waste management" and "environmental problem" in India. The objective of this analysisis to research about the health care waste management system, including practices and compliances. Most countries of the world, specially the developing countries, are facing the grim situations arising out of environmental pollution due to pathological waste arising from increasing populations and the

consequent rapid growth in the number of hospital servicing units. There are nearly 6 lakhs hospital beds, over 23,000 primary health centers, more than 15,000 small and private hospitals in India. The Biomedical Waste (Management and Handling) Rules 1998 makes it mandatory rule for all hospitals, clinics, and other medical and veterinary institutes to dispose of bio medical wastes strictly. The few studies on bio medical waste management from India have been established that, those hospitals did not manage health care waste properly according to the India health administration rules. The hospital waste management sector market revenue (2008) is 8% of the total waste management revenue in India expected growth in next 5-6 years is around 20%.There are many institutions polluting the environment but recently the ignored field which produces the pollution by way of hospital wastes.Attracts the attention of the environmentalists are the hospitals, dispensaries, medical shops, medical clinics of doctors and other paramedical staff. Safe handling, segregation, storage, separate storage containers, subsequent destruction and disposal of hospital waste ensure mitigation and minimization of the concerned health risks involved through contact with the potentially hazardous material, and also in the prevention of environmental contamination. Mismanagement of health care waste disposal methods are causingthe dangerous infection, virus spread and possess a potential threat to the surrounding environment, persons handling it and to the public. In the past, medical waste was often mixing with household waste and disposed of in municipal solid waste landfills and other normal methods. In recent years, increased public concerns over the improper disposal method of health care waste have led to a movement to regulating the waste more systematically and stringently by the Indian government.

ANALYSIS AND INTERPRETATION
1. Solid waste Generated from hospitals
Waste from healthcare is categorized as potential infectious waste and non-infectious waste. Infectious wastes include infectious sharps and infectious non-sharp materials. Infectious Sharpsconsist of syringe or other blades, needles, infusion sets, broken glass or other items that can causedirect injury.

Infectious non-sharps include things that have been in contact with human blood, or its derivatives, swabs, bandages or items soaked with blood, isolation wastes from highly infectious patients (including food residues), used and obsolete vaccine vials, bedding and other contaminated materials infected with human pathogens. Human excreta from patients are also included in this category.

Non-infectious wastes may include materials that have not been in contact with patients such as paper and plastic packaging, metal, glass or other wastes which are similar to household wastes

In and around of Palani taluk, healthcare service units like hospitals, nursing homes, clinics, laboratories, animal/ Veterinary clinics and blood banks including 14 multi specialty hospitals are under private contractors to manage their wastages. Even though government hospital wastages have been collected and disposed by private contractors. Medical wastages and all not mingle with normal household and commercial units garbage's due to environment safety and disposing procedures. Because medical wastages may produce toxic while burning or dumping in open ground along with other decomposing wastages. That's the main reason to handling all the healthcare service units wastages are having conscious procedure, those procedures are handling properly by private contractors who are all authorized to do that.

Palani Municipal Corporation completely free from handling solid waste management of healthcare units and private contractors are handling the wastages. So, Municipal Corporation has no liable to handle these wastes.
2. Solid waste Generated fromTemple
Regarding solid waste management system of temple, has been divided into two team. One is solid waste managed by Municipal Corporation and another one is devasthanam. Under devasthanam Palani Muruga temple (hill), Thiruavinankudi temple, Perumalkovil, Periyanayagiamman temple and Mariamman temple wastages are collected by devasthanam team. All other remaining temple wastages are collected normally by sanitary workers on daily basis.

"Palani Muruga Temple" wastages are handling by the temple management workers, like all the collected wastes from temple like food, coconut scrub, flowers, cloths and leaf are dumped and disposed separately back side of temple itself. Remaining temples under devasthanam management are taken care by separate vehicles and collected together, and then finally disposing same place where municipal corporation sanitary workers disposing town garbages.

Only the banana wastages from 7 panjamirudham production madabams are collected by municipal corporation sanitary workers during normal days on an average 300kgs to 400kgs of banana waste, during festival time wastages level depends upon the crowd. Commonly 6 to 7 tons of wastages have been collected from these mandabams.

Table – 1 Banana Wastes during the Festival time by quantity

Quantity	Thaipusam	Panguni Uthiram	Karthigai	Summer Holidays
Below 500 Kgs	2 (28.6)	2 (28.6)	7 (100.0)	5 (71.4)
500 Kgs to 1 Ton	1 (24.3)	2 (28.6)	0 (0.0)	2 (28.6)
Above 1 Ton	4 (57.1)	3 (42.8)	0 (0.0)	0 (0.0)
Total	7 (100)	7 (100)	7 (100)	7 (100)

Source: Primary data

Table reveals that 7 madabams are taken into consideration which is made panchamritham under Devasthanam, Palani. Sales take throughout the year, especially festival time it reaches peak. Four festivals are treated as most important due to flow of devotees such as Thaipusam, Panguni Uthiram, Karthigai and Summer Holidays (Agni natchathiram) also treated as peak season. During that time the banana wastes are comparatively huge collected by Palani Municipal Corporation.

Normal days it would be 300 kg to 400 kg of wastes were handled by the municipality. In peak season, out of four, Thaipusam and Panguni Uthiram are significantly more sales in panchamritham so that wastes were high. Of these at the time of Thaipusam, municipality would handled more than 1 ton of banana from 4 madabams it contributes 57.1 per cent followed by Panguni Uthiram 42.8 per cent. Thaipusam festival is famous for lord Muruga; so many devotees are come by pathayathirai.

Analysis of Banana Wastes during the Festival time

Festivals	Mean Score	Average Score	Ranks
Thaipusam	397	99.25	I
PanguniUthiram	358	89.50	II
Karthigai	326	81.50	III
Summer Holidays	312	78.00	IV

This table reveals that ranking of banana wastes are collected during the peak season which are identified as Thaipusam, Panguni Uthiram, Karthigai and Summer Holidays (Agni natchathiram). Garrett Ranking is used and described as Thaipusam leads first followed by Thaipusam, Panguni Uthiram, Karthigai and Summer Holidays (Agni natchathiram).

Mandabam wise Banana Wastes handled by Municipal Corporation

Mandabams	Thaipusam	Panguni Uthiram	Karthigai	Summer Holidays
1	Below 300 kgs	Below 300 kgs	Below 300 kgs	Below 300 kgs
2	Above 1 ton	Below 300 kgs	Below 300 kgs	Below 300 kgs
3	500 kgs – 1 ton	Below 300 kgs	Below 300 kgs	Below 300 kgs
4	Below 300 kgs	500 kgs – 1 ton	500 kgs – 1 ton	Below 300 kgs
5	Above 1 ton	500 kgs – 1 ton	Below 300 kgs	Below 300 kgs
6	Below 300 kgs	Below 300 kgs	Below 300 kgs	Below 300 kgs
7	Below 300 kgs	Below 300 kgs	Below 300 kgs	Below 300 kgs

Source: Primary data

This table explains banana wastes collected from the 7 madabams under the control of Palani Hill Temple Devasthanam by Palani Municipality. These wastes are recycled and prepared as manure. During the mentioned festival time, he wastes are collected at the range between 300 – above 1 ton. Of these 7 madabams Mandabam 5 contributes more banana wastes for preparing manure followed by Mandabam 2 and Mandabam 4. Manures are usually sold to farmers.

Findings

1. Healthcare waste may pose health risks indirectly through the release of pathogens and toxic pollutants into the environment.
2. Out of four important festival, Thaipusam and Panguni Uthiram are significantly more sales in panchamritham so that wastes were high.
3. At the time of Thaipusam municipality would handled more than 1 ton of banana from 4 madabams it contributes 57.1 per cent.
4. Out of 7 madabams, Mandabam 5 contributes more banana wastes for preparing manure followed by Mandabam 2 was contributed more for manure preparation.

Suggestions
1. To Healthcare:
1. Know the healthcare waste laws. Healthcare waste is regulated by the DOT, EPA, OSHA, and the DEA.
2. Classify medical waste by type.
3. Use the right medical waste containers.
4. Include the right documentation.
5. Use the medical waste disposal color code.
6. Hire the right waste disposal company.

2. To Temples:
1. Flowers into herbal incense sticks.
2. Coconut shell as can be used in concrete construction cement.
3. Handmade paper production.
4. Veterinary feeds.
5. Herbal oils and syrup.

Conclusion

The exhaustive review of various methods of utilizing temple waste for one or the other useful product like vermicompost, biogas, dyes, incense sticks, concrete aggregate replacement etc. suggest that the temple waste can not only be disposed safely in an environmental friendly manner but can also be utilized for making diversified products. This study will propose an alternative approach to waste management since the waste will neither be land filled nor burnt but would be used as a resource that will be recycled.

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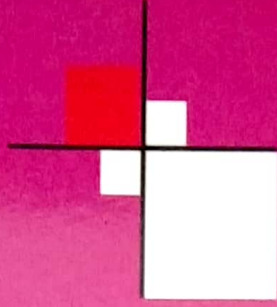
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SOCIAL MEDIA PLATFORMS ENHANCE THE BUSINESS OPPORTUNITY FOR THE WOMEN ENTREPRENEURS

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Abstract

A remarkable growth among women entrepreneurs operating on social media platforms in India has been observed within the recent years. This is often indisputably considered an enormous contribution to the economy of the country as women comprises of half the entire population. Hence, this study aims to explore the factors that have influenced women to do their businesses through social media, and therefore the way these reciprocally have opened doors of entrepreneurial opportunity for them including, entrepreneurial opportunity, technical adaptability, work-life balance, product improvement and development, network-building, access to information, cost efficiency, and promotions. The study further finds social media and entrepreneurial opportunity for women entrepreneurs within the urban areas. It's important to note from the findings that the benefits of running a business on social media have certainly contributed to women entrepreneurship. However, product improvement and development, and promotion, have an enormous relationship with entrepreneurial opportunity.

Keywords: Women entrepreneurs, Social media, and entrepreneurial opportunity

INTRODUCTION

In modern days social media is developing as a robust tool for gender empowerment. it will bring new information resources and might open new communication channels for women entrepreneurs of marginalized communities. Women empowerment through social media need training, planning, designing, implementation, monitoring assessment, paying attention to the effect on women's lives and their conditions. Government plays a significant role in creating a positive policy environment because they take a central role within the progress and·use of social media among women entrepreneur and become a innovative user of e-commerce and its function for empowering women.

Recently social media service was launched for women entrepreneurs to support their business through mobile wallets. Now, women entrepreneurs are going to be ready to use the customized social media service to purchase or sell their products through mobile financial services. On line payment rather than paying with cash, cheque, or credit cards, a consumer can use a mobile to shop for services. Online marketing sites are the primary interfaces where consumers are familiarized with new products and services. Customers can compare products and share their experiences with others, which are essential elements in creating brand images resulting in both first-time and frequent purchases. the net market exceeds geography and offers huge opportunities for expanding the customer base. it's a rapidly growing sector that influences local and international trade. Social networks are critically important to the entrepreneurial process and are central to business venture success

SOCIAL MEDIA IN BUSINESS

Social media platforms aid a good spectrum of purposes; it encompasses social communication, business, marketing, advertising, banking, acquiring information, and entertainment. Most social media applications and websites are liberal to use, aside from other costs like data downloading and subscription fees for a few social media applications. These applications facilitate freedom of communication and expression. Moreover, users are able to disseminate online content and communicate almost instantly with others thousands of miles away, with just a couple of clicks and an honest internet connection.

In the contemporary digital world, many websites and mobile phone applications are used for communication, commercial purposes, and for social connections. Online social networking sites and applications created to enhance social connections between friends and relatives weren't initially intended for business functionality (apart from the websites/applications

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CREATIVE RESEARCH THOUGHTS

Changes in Life Style Behaviors during COVID 19

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Abstract

The COVID-19 pandemic addresses an amazingly enormous effect on human health, causing a rapid way of life changes, such as social separating and isolation at residence, with cultural and economic results. Enhancing public health during this pandemic requires not just comprehension from the medical and biological sciences, but additionally of all human sciences identified with way of life, social and conduct consider, including dietary propensities and way of life. Most of the employees are losing their job and most of the corporate has changed their work culture. COVID 19 period traditional work culture has changed to work from home culture. People are staying in their home no one migrates to other place or going to the relative house. In beginning one or two months everyone enjoys with their family. After few months it was difficult to lead their family. Due to home confinement, several changes are occurring in human life one of the big challenges is that his /her lifestyle behaviors are changed. In this study mainly focus on lifestyle behavior changes like eating habit, physical exercise, and sleeping habit. Data were collected from 60 respondents. By using two-way ANOVAs test for testing the hypothesis.

Key word: Life style behaviors, eating habit, physical exercise and sleeping habit.

Introduction

India has the second-largest population in the world. Nutrition and physical activities are the fundamental aspects of human health. This lifestyle behavior has been facing great challenges in COVID 19 pandemic condition. COVID 19 infectious disease was the first outbreak in December 2019 in Wuhan city of central Hubei province of China. This infectious disease spread easily all over the world, to control the spread of infectious disease the state and central government announced complete lockdown across the country. Some of them lose their job. Most of the corporate companies have started work from home policy. Globally this is the first time in a new environment for all. People faced big challenges to balance a new working environment. Under a new working environment, there was no time limit for working. Work from home environment

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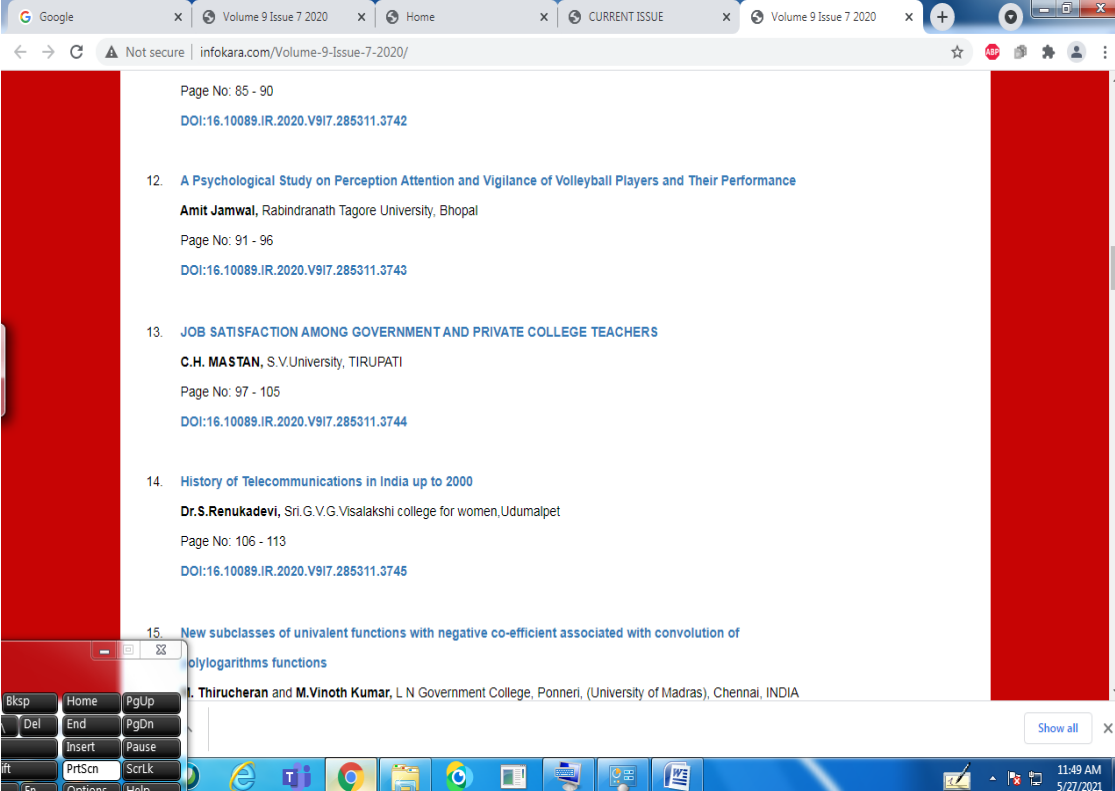
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History of Telecommunications in India up to 2000

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Abstract

Like the ocean that is made of tiny drops, the Postal and Telegraph (P & T) had a slow and uneasy start and occupied a small corner of the public works department. Tele means far off, distant, or remote. Practically speaking, the word. Telecommunications means communication by electrical or electromagnetic. Electromagnetic means, usually over a distance. The telecommunication means communication by wire. Although this is still accurate in many situations today. It is not complete because telecommunications can also occur using optical fiber or radio waves.
Telecommunications was used in ancient times; Cave men used fire to communicate simple messages over a long distance. Similarly, drums, smoke signal, and the printing press were used by cultures long before electricity or magnetism was known. Humans have always had a need to communicate over distances and have found ways to do it without sophisticated tools.

Key word:

Telecommunication,   Growth and Development of Telecommunication, Facilities, Networks, Uses, Availabilities, etc.

Introduction:

Telecommunications in India were introduced in 1851 near Calcutta by the British government, when the first telegraph lines were laid. Only 5 years after Alexander Graham Bell invented telephones in 1881, British firms introduced POTS (plain old telephone services) into the colony. By the time India was independent in 1947, the country had 321 switching centers (telephone exchanges) in urban areas and a tele - density of 0.25 phones per thousand people. During the state-led planned economic policies till the mid 1980's, the government controlled all aspects of the telecommunications sector through the ministry of Posts and Telegraph as a natural monopoly. Telephones continued to center around the urban and metropolitan centers and rural coverage did not receive much attention because of "the perception that phones were a luxury and rather than essential infrastructure for efficient administration of government and industry", was written by Bella Mody in Journal of Communications in 1995.Stephen McDowell in his treatise of political economy of the communications sector also takes the same view

stating: Telecommunications technology and services did not assume a high national priori

until the Seventh Economic Development Plan (1985-90). It is widely claimed the telecommunications were seen by policy makers up until the early 1980's as luxury services not essential to essential to economic growth. But that may not have been the only reason. An Indian commentator argued in 1981 that the urban bias was dictated by the fact that: The direct and tangible benefits of telecommunications expansion in rural areas being small, there has been a tendency so far to leave those areas alone and concentrate on urban areas, which give handsome returns to capital.

Till 1980's:

Till the 1980's essential components of telecommunication service policies, where a telephone network was not in place, were policies for producing and purchasing network equipment, for funding network expansion, and for organizing public organizations to provide telecommunication services. In 1981, the government appointed a high-power committee (Sarin Committee) to look into organizational issues at the Ministry of Posts and Telegraph. This was in response to increasing public outcry and Parliamentary questions about the inadequacy of the level of service, the high prices and the unavailability of telephones. The committee submitted over 400 recommendations to the government including ones to split the MPT into two divisions, urged the government to immediately import 100,000 telephone instruments and suggested collaboration with foreign telecom companies.12 Despite the strong calls for change, the telecommunications bureaucracy was not convinced. The MPT was more concerned with defending its turf against the newly formed Department of Electronics.Despite the ministry's attempts to damp down the criticism, telecommunications were a focal point of public debates between 1980-1983. As McDowell argues: "The importance of telecommunications had risen in the administration of Prime Minister Indira Gandhi in the early 1980's and was accentuated in the new government of Rajiv Gandhi who became prime minister in 1984. The telecommunication policy model that emerged at this time in India, combined some liberalization of imports of computer and information technology with the allocation of more state resources to develop national telecommunications equipment research and development capabilities.

After the Public Accounts Committee of the Lok Sabha recommended a complete overhaul of telecommunications, "which was working in a most unsatisfactory manner in 1985," a long sought re-organization was undertaken in 1986 to split the public postal and telecom operations into separate departments. Analysts, at the time, argued that the different technological needs of the postal and telecommunications activities necessitated the break and that it would allow greater attention to be paid to telecommunications role in development. By now, the bureaucrats had also jumped on this bandwagon and were using it to defend themselves in the face of mounting criticism. The chief telecom bureaucrat in 1983 quoted by McDowell makes the point: "Telecom investments deserved the priority given the economic fall-outs in other sectors, but surpluses were being siphoned off to cover the postal deficit."

Telecommunication Network in India

India's fixed line network has a direct exchange line capacity of 14.53 million with a present teledensity rate of 1.3 per cent. The growth in Indian domestic telecommunications network is shown in Table. The number of lines in service have grown at a compound annual rate of almost 20% since 1992. However despite this growth the waiting list has remained high.

Table

Network Development, 1992-96 (*Source:* Case Study)

Indicate	1992	1993	1994	1995	1996
Telephones in service (thousands)	6'706	7'713	8'877	10'588	12'892
Telephones lines per 100 inhabitants	0.77	0.88	0.99	1.15	1.38
New lines installed (thousands)	735	987			
Lines in service	5'810	6'797	8'026	9'795	11'978

(thousands)					
Lines in service per 100 inhabitants	0.67	0.77	0.89	1.07	1.28
Long-distance route kilometres	94'476	107'462	122'957	142'113	168'633
Number of village public telephones	74'404	104'476	137'477	185'136	216'632
Number of village public telephones)	29.8	40.1	46.7	58.6	78.5

Estimates suggest that demand for basic services will be in the region of 64 million lines by the year 2006, requiring a capital expenditure of US $ 47.5 billion (Rs 1,700 billion or Rs.26 thousand per line) in total.

File Formats for Telecommunications

- o   The telecommunications consists of four variables they are
- o   The amount of data per unit(Data block),b)The wait time(or) How long each side will wait before giving up,c).Signal(or) character indicates that the information was received successfully).The error detection and correction scheme.

These variables are present for each protocol. This section looks at a range of file transfer protocols that make it possible for a laptop, to transfer files with another computer.

The Functions of the Telecommunications Department

The telecommunications organization reports, that it has a certain set of responsibilities and activities to perform. The parts of the telecommunications organization are analogous to the major functions of the company, such as marketing, engineering and production. The telecommunications is in need of knowledgeable people to design, install, repair, maintain and operate the system. Thousands of people work behind the scenes' to sell, design and install telecommunications systems and keep them operating reliable and properly. Network analyzers and designers want the people to know the knowledge about types of telecommunications hard

ware and services that are available. So these people easily identify the communication requirements for a company and then design a telecommunications solution that will provide their required capabilities. Telecommunication is very helpful to the finance, accounting and marketing also. Several universities offer degrees in the technical and management aspects of telecommunications to help the people get the best possible preparation for a career in this exciting field.

New Facilities and Services of Telecommunication

Many new communications facilities, including networks (Both wide and local area), for building wiring, equipment. Facilities and services should be designed in response to a statement of requirements based on the users need. Installation activities range from simple repetitive installation of new telephones and computer terminals to infrequent but complex tasks, such as installing new PBx front-end processors, are project oriented. Project management skill and techniques are important.

Availability

Availability is having the system or service operating when the user wants or needs to use it. For example, the telephone system. User expects telephone service to be available anytime, 24 hours day, 7 days a week, and 365 days a year. What would it be like if the telephones did not operate during certain hours, say from 10p.m to 7p.m., or during the lunch hour, or on holidays? The real requirement for availability varies by application. Many data applications in business need to be available only during hours.

Direct use on the Job

Telecommunication is becoming an integral part of the work. So telecommunication is very useful to many different types of the job, including automated teller machine at a bank, the supermarket, checkout scanner that reads bar codes on food products, librarian uses to check books out of the public library, clerk at the internal revenue services, uses to enter the income tax information from a taxes into the computer. More and more people are using computer terminals connected to computers via telecommunication lines.

Indirect use on the Job

Knowledge of the subject and its vocabulary will help to communicate with` `telecommunications workers'. It could help them to knew information or services and understand the problems; they are suddenly thrust into a new job where to work directly with telecommunication terminals or equipments.

Death of DoT

There have been a slew of policy decisions in the telecom sector during the second half of the year 2000. Following on from the National Telecom Policy in 1999, the government has kept up the speed of reform in this sector. Part of this realization to speed up reforms follows the noticeable slowing of foreign investment in this sector during the past one year. The most significant change in the Indian telecom sector took place on October 1, when the Department of Telecom Operations, the operations arm of the DoT was turned into a corporation, Bharat Sanchar Nigam Limited (BSNL). With this, the operational and policymaking arms of the DoT have been moved an arm's length distance away. The new corporation will be a Fortune 500 company from inception with assets of Rs64,000 crore ($14.25 billion). The corporatisation was preceeded by a long spell of strikes from the 400,000 strong-employees of the telecom department, who wanted to retain the salary, pension and perks structure of a government employee even after being transferred to the new corporate entity. The strikers were not only from the various low-skilled employees' unions but also from the civil service cadres; the Indian Telecom Service Officers and the Indian Accounts Service officers working in the telecommunications department also went on strike to ensure that the ITS cadre survived the corporatisation and were not replaced with IAS officers. The strike, which crippled local, national, international voice services as well as internet access services nationwide was only called off after the communications minister Ram Vilas Paswan agreed to meet all the demands of the employees, like government-scale pensions, out of a consolidated government fund and the turning 30,000 ad-hoc employees into permanent ones.

However, as many commentators have pointed out the rapid capitulation of the government in the face of striking telecom workers' demands has effectively called into question the very basis of the move to corporatize telecom services. According to The Statesman newspaper, the political message is all too clear: vital services will be saddled with extortionate baggage before they can be reformed, because the government doesn't have the courage to take strong disciplinary action. Other commentators have pointed out while the demand for pensions to be protected was going to be accepted by the government, promises that corporatised entity will guarantee jobs and never retrench workers and that the corporation will never turn sick are absurd. It remains to be seen how much difference the arms length relationship between the government policy makers and the government-owned telecom behemoth BSNL will make in terms of a level playing field for all telecom service operators. However, the initial signs are that corporatization may be leading to a level playing field for all telecom service providers. For instance, within a fortnight of the creation of BSNL, the DoT asked it to pay Rest 500 crore ($125 million) as spectrum charges for operating various wireless services like microwave and satellite links. While as a government department, it had no need to pay for scarce resources like the spectrum, as an independent corporate entity (albeit 100 per cent owned by government) it has to follow the rules applicable to other players.

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From

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Women's Health and Nutrition Special Reference to Tamilnadu

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Abstract

The past two decades have witnessed several national and international initiatives in the area of women's health. For centuries, women have been in total subjugation in male dominated,patriarchal societies. Relationship between the husband, wife and child that is a prescribed one, determines the roles that men and women perform within the family and society. In this patriarchal and discriminatory society, womanhood is represented in sacrificing and loving mothers, tolerant and loving wives,as seen in the 'natural law' of being subjugated and regarded as the inferior sex.This had resulted in women suffering silently from a large number of reproductive illness, which were termed as the 'silent emergency.'

Keywords :- Nutrition , society, women's health.

1.Introduction

Nutrition plays a crucial role in human health and well being. At the national level, despite higher economic growth, improvements in human development indicators like nutrition levels of the population have been unacceptably slow. A large number of Indian children are stunted. A substantial number of Indian children and women are underweight, anaemic and suffer from micronutrient deficiencies. To address these concerns, the Central and State Governments have been channelizing substantial resources into various health and nutrition schemes and programmes like Integrated Child Development Services (ICDS), Mid-day meals, Reproductive and Child Health Programmes (RCH) and National Rural Health Mission (NRHM). However, an effective scaling up of these efforts is required to mitigate the incidence of under-nutrition in the country.

Studies in Indian women of a high-income group (Ramachandran 1989) have shown that their dietary intakes range between 2000-2500 kcals per day during pregnancy. In this group, women generally do not perform hard physical labour and there is a reduction in activity during pregnancy (NIN 1983). The average weight of this group ranges between 45-55 kg and the mean weight gain during pregnancy is about 11 kg - observations similar to those reported in women from developed countries.

Studies in urban women of a low-income group have shown that their dietary intakes range from 1200-1600 kcals per day. The average pre-pregnancy weight of these women is around 43 kg and they gain 6 kg during pregnancy. In rural India, dietary intakes of women are slightly higher (1600-1900 kcal). However, rural women have to spend more energy in daily household chores. For instance, they have to fetch drinking water from sources which may be 1-2 kilometers away from

home, and gather and bring firewood from forests miles away. Most rural women from low-income groups are heavily engaged in agricultural activities. It is therefore not surprising to find that these women weigh less than the urban women. The NNMB surveys showed that the average weight and height of rural women are 42 kg and 152 cm. About 33% of 18 year old women have body weights below 40 kg and 15 percent have heights less than 145 cms (NNMB 1991). These women fall into high risk category as they are likely to suffer from obstetric complications and give birth to small babies.

Tamil Nadu has played a pioneering role in bringing about significant changes in the health and nutrition status of children under six years of age, pregnant women, lactating mothers and adolescent girls. The Government of Tamil Nadu's successive budget outlays for nutrition and health are the highest in the country. The performance of the ICDS scheme and the Puratchi Thalaivar MGR Nutritious Meal Programme (PTMGRNMP) in Tamil Nadu are considered one of the best in the country. The Government of Tamil Nadu's policy for "A Malnutrition Free Tamil Nadu" guides the State's long-term multi-sectoral strategy for eliminating malnutrition. The goal is "*reducing human malnutrition of all types to the levels of best performing countries".* In Tamil Nadu, ICDS is being implemented through 54,439 Child Centres (comprising 49,499 Anganwadi Centres and 4,940 Mini Anganwadi Centres) in 434 Child Development Blocks (385 rural, 47 urban and 2 tribal). With steady expansion into unreached areas, increasing coverage of marginalised groups, enhanced allocations and enlarged scope of services, ICDS is now considered to be one of the world's largest programmes of its kind and a model for the holistic development of the child. To ensure that services reach the intended beneficiaries, the programme has been

universalized and convergence promoted with allied departments dealing with health, education, drinking water, sanitation etc.

2. Origin of SHGs in Tamilnadu

In Tamilnadu the SHGs were started in 1989 in Dharmapuri District. At present 1.40 lakh groups are functioning with 23.83 lakh members all over Tamil Nadu. Many men also venture to form SHGs (Vinayagamoorthy, 2007). As on 30.06.2006, there were 3,19,713 SHGs under Mahalir Thittam with a total savings of Rs.1,127.89 crores in Tamil Nadu. 22,44,939 women members have been mobilized into 1,31,749 self help groups in the state. There are 1,26,404 rural Self Help Groups (21,46,856 members) and 35,735 urban Self Help Groups (6,03,518) in Tamil Nadu. The self help groups have mobilized a savings of Rs.439.34 crores (Mahalir Thittam 2004). Besides savings SHGs are running ration shops, internet kiosks,Floriculture dairy farming, courier services etc, with substantial success (Government of Tamil Nadu policy Note, 2007). The Tamil Nadu Women Development project (TNWDP) was set up for implementation by the Government of Tamilnadu through the Tamil Nadu corporation for Development of Women Ltd in eight districts of Tamil Nadu in 1989-90 (Kala, 2004). The Tamil Nadu Women Development Corporation launched a series of training programmes for the members of women's Self Help Groups of the Mahalir Thittam through different departments and agencies. The Tamil Nadu Women Development Corporation has been the main source of inspiration for formation of thousands of groups by Arivoli Iyakkam, TANWA, SGSY, Banks and NGOs (Suguna 2001). Entrepreneur Development training has been given to 22000 SHG women and skill training to 3000 SHG women and skill up gradation training to 650 SHG women (Social Welfare and Nutrition's Meal Programme Department, 2005).

The State Government has set apart Rs. One crore for establishing a state level retail centre to sell products made by Self Help Groups (Government of Tamil Nadu, 2007). The Government supports and motivates women to join SHGs. It has a plan of covering 35 lakhs over the next four years. (Balaganessen, 2005). It is seen that the number of SHGs linked with banks was 7,17,360 at the end of March 2003 (Loganathan, 2007). In Tamil Nadu, out of 56,129 SHGs.

32,433 are assisted by commercial banks, 17,743 and 5,953 SHGsare assisted by Regional Rural Bank (RRB) and Primary Urban Cooperative Bank (PUCB) respectively (Venkatachalam, 2005). Women in Tamilnadu are encouraged to become entrepreneurs. There are around 14,000 SHGs who have been economically assisted for producing a wide range of products. The number of products produced by SHGs is bound to multiply over a period of time (Gariyali and Vetrivel, 2004). The Government of Tamil Nadu had constituted 225 village shops and 28 district marketing complexes for the use of SHGs. Fourteen complexes are also in proposed at tourist places in Tamil Nadu (Tamil Nadu Women Development Corporation,2007).

Reddy and Venkatesh (2006) list lack of motivation, managerial and behavioral competence, absence of mentoring and women role models, lack of collateral security. Lack of proper training and knowledge, over dependence on intermediaries, inability to get competitive prices and family lifestyle and role conflict as the causes for failure in enterprises by SHGs.

3. Advantage of SHGs.

Gurumoorthy (2000) maintained that SHG is a viable alternative to achieve the objectives of rural development and to get community participation in all rural development programmes. It is also viable organizational set up to disburse microcredit to the rural women for the purpose of making them entrepreneurs and encouraging them to enter into entrepreneurial activities. Credit needs of the rural women can be fulfilled wholesomely through the SHGs. The women led SHGs have successfully demonstrated how to mobilize and manage thrift appraise credit needs maintain linkages with the banks and enforce financial self discipline. SHGs enhance the quality of status of women as participants, decision makers and beneficiaries in the democratic economic and social and cultural spheres of life. They encourage women to take active part in the socio-economic progress of the society.

As per the Population Census 2011, women constitute nearly 50 percent of the population in Tamil Nadu. The well being of a family depends on the health of women and nutrition forms the basis for a sound health. The Twelfth Plan will focus on eradicating malnutrition in women. The ICDS in the State, concentrates on nutritional improvements of pregnant and lactating women. The ultimate objective is to enhance the nutritional status of women thereby improving productivity and human capability. Prevention of maternal undernutrition (hidden hunger) is a long term investment that will benefit the present and also future generations.

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THAGADUR IN SANGAM AGE

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Abstract

Thagadur region was included by Kurinji and mullai tracts. Terrain was uneven in nature. In the same time many hills and mountains were dotted in this regain. In Southern side Kalrayans hills, Servarayan hills and Javvadhu hills were bordered. Between these mountain ranges some passes also exist. They are Changam pass and Thodampatti pass. Manjavadi pass is also located between Kalrayan hills and Servarayan hills. In western frontier Alampadi pass, Melmalai pass and Thirtham pass are located. These are the passes through which alien people migrated into Thagadur nadu. Adhiyamans ruled from Sangam age to the fourteenth century A.D. with some interruptions. The history of the Adhiyaman lineage is divided into three divisions' viz. Sangam age, Early medieval and later medieval periods. Gangas, Banas, Pallavas, Nulampas, Cholas, Hoysalas and Vijayanagara rulers were ruled from this city. Whether the Dharmapuri was kept as capital city of them or created a new capital city for their rule is also taken up for the article.

Key Words: Kurinji, Thagadur, Adhiyaman, Dharmapuri, Sangam, Purananuru

Introduction:

During the Sangam period Tamil country was ruled by the Cheras, Cholas and Pandiya rulers. The Adhiyaman rulers were also ruled in Thagadur nadu as chieftains. They called themselves as descendants of the Chera rulers. Some medieval inscriptions mention about this relationship. From Chera lineage who ruled from Kavery was the original lineage of the Adhiyamans. Sangam literature "Thagadur Yathirai" mentions this relationship. Thanjavur was the capital city of the Cholas. Karuvur was the capital city of the Cheras and Madurai was the capital city of the Pandiyas. This is attested by literatures and inscriptions. Thagadur was the capital city of the Adhiyamans. In this article chiefdom of Adhiyamans and their capital city Dharmapuri are to be analysed.

LOCATION OF DHARMAPURI

The location of the capital city of Adhiyamans is debatable subject among historians. They based the date from Sangam literature. First one must have processed the Sangam literature date. Purananuru song (158) describes the Adhiyaman capital as following.

"ஊராதுஏந்தியகுதிரைக்கூர்வேல் கூவிளங்கண்ணிக்கொடும்பூண்எழினியும்"[1]

Elini who was the owner of the Kuthirai hill and garlanded with Kuvilam flowers. He had the shaped lance and beautiful ornaments. He was victories in many battles. These are mentioned in a song which is already mentioned.[2] Another one song is also discussed about the walls of the fort around the city. It is also given below.

"நெடுநெறிக்குதிரைக்கூர்வேல்அஞ்சி கமடினஅலைந்தகொடுவில்ஆடவர்"

It mentions the term "musai" which was the frontier guard of the enemies. These frontier guards were destroyed by the army man of the Adhiyaman king Anchi. These army men were guarding the Thagadur. In Purananuru song (168) Kuthiraimalai was mentioned as PittanKorran hill[3] the location of the Kuthirai hill is not so far fixed. The infrastructure of the Thagadur is to be analysed.

The identification of Kuthiraimalai is the controversial subject.According to the Pandaratharit is located in south Karnata region. Nowadays it is called as Kuthiraimooku. K.K.palli identified with a hill in Srilanka, from where Adhiyamans originated. When they occupied Thagadur region is not identified. K.D.Thirunavukkarasu identified Kuthiraimalai by the area name near Udumalipatti in Coimbatore District. From there Adhiyamans migrated to Thagadur region. C.Santhlingam said that Ranimukku hills near Kadathur was the Kuthirai hills of Adhiyamans.[4]

According to Marxiya Gandhi in North Western frontier of Tamil Nadu some hill ranges are located. Among these hill ranges Kuthiraimalai must have been located. In course of time the name of Kuthirai hill was forgotten by them. However there must have been a hill which was owned by Adhiyamans.[5]

U.V.Swaminathaiyar, the great Tamil scholar identified Adhiyaman from an inscription from Thirumali near Vellore. According to him Adhiyamans were originated from Chera lineage. He was called as Elini. His son Rajaraja succeeded him. He was succeeded by Vidukathalagiyaperumal.[6] Pandiya king defeated the Adhiyaman king near the Kaveri River. So they were came from Kerala region and settled in Thagadur region. Internal structure of the city Thagadur was mentioned in a Purananuru song. (390) According to this song big natural hills are surrounded like a compound wall, built around the castle. Enemy soldiers seldom entered the gateway. Always the city was covered by the brave soldiers. The song runs like this.[7]

"அரும்பலர்செருத்திநெடுகான்மலர்கமழ் விழிவணிவியன்கலம்அன்னமுற்றத்து ஆர்வலர்குறுகின்அல்லதுகாவலர் கனவிலும்குறுகாக்கடிஉடைவியன்நகர்

மலைக்கனத்துஅன்னமாடம்சிலம்பளன்
மலர்அயர்அணியும்தலைநீர்நாடன்"

The mountain like buildings standing around the city and it looks like a city within the compound. Another song from Perunthogai gives a vivid description of the city.

"மறன்உடைமறவர்க்குஏறஇடனின்றி
நெய்யோடுஜயவிஅம்பிஎல்வாயும்
எந்திரப்பறவைஇயற்றினநீறிஇக்
கல்லும்கவணும்கடுவிசைப்பொறியும்
வில்லும்கணையும்பலபடப்பரப்பிப்
பந்தும்பாவையும்பசுவரிப்புட்டினம்
என்றிவைபலவும்"[8]

It is impossible for the enemies to claim in the fort walls of the Adhiyaman fort. Ghee and oil were paved on the fort walls and which gives difficulties for the soldiers to claim in the fort walls. There are mechanic birds which catch the soldiers. In the same time throwing stones, bow and arrows and moving weapons are fixed in the fort walls. So the soldiers could not easily claim in the fort walls. Boxes of arrows are also kept in the top of the fort walls.

The traditional Chronicles "KonguDesa Rajakkal" mentions about the city of Thagadur in which market streets and commodities are kept in the city. In the same time the merchant streets are also praised by the poet. On the basis of the above infomation Pulavers. Raju said that the present Dharmapuri was the ancient Thagadur[9]

SANGAM AGE

Sangam age was the early historic period in Tamil history. There was no writing system in pre Sangam age. Only graffiti marks were in practice. In Harappa civilization graffiti symbols were used. This graffiti system was used by pre Sangam period. Pre Sangam age was called as Iron Age culture by the historians.

There were no written documents in the Sangam period. So historians fixed the date of the Sangam age on the basis of Sangam literature. In same time chronology was also fixed with the help of literature data. Sangam literature was copied from the palm leafs. When coping the literature new ideas were introduced by the copier. Hence literature mixed with many fictions. In this situation differ opinions between scholars are persisting. After the ancient texts were copied many texts were destroyed. Soone must be careful in using literature data. Some historians were very happy with phrase "கல்தோன்றிமண்தோன்றாக்காலத்தமுன்தோன்றிமூத்தகுடி" which purely imagination. In dating Sangam period differences of opinions are existing till date. Few historians

fixed the age of the Sangam period between 1000 B.C to 300 B.C. Another one date was also introduced by the scholars i.e. between 300 B.C. to 300 A.D. On the basic of anthropological and archaeological views this opinion is accepted by the scholars.

URBAN CENTERS OF SANGAM AGE

Sangam literature is a collection of songs and it praise the kings like Chers, Cholas, Pandiyas and other small chieftains in Tamil Nadu. Each kingdom had its own kingdom and capital city. Some of the kings called their name with the name of the city. Korkaikoman (king of Korkai), GunapulamKoman (king of Eastern region) and Kadalvaluthi, Koliyuran, Kavirinadan, Ponnainadan and Thanrikon are few examples. Tamil country had their own urban centers.[10] Sangam literature mentions seven chieftains and their capitals. Thagadur is one of the important city among them. It is difficult to locate Sangam period Thagadur.

The archaeological evidences belong to early medieval period. Hence some historian had their own doubt about the location of the Thagadur. To locate the exact place of Thagadur is the main theme of this article.[11]

EXCAVATION IN DHARMAPURI REGION

The literature and archaeology data are main sources to identify the location of the Thagadur. Literary data gives the location and natural boundaries of the city. Archaeological data give the picture of the people life. In the same time archaeological data conform the location of the city. Natural boundaries were mentioned in Sangam literature included with this. To locate the city of Thagdur many archeological explorations conducted by some archaeologists. In the exploration many data were collected from Mayiladumpari, Adhiyamankottai, Guddur and Modur. Excavation at Mayiladumpari yield archaeological data for conforming the human life before 5000 years. But no data available for Sangam period. This place is surrounded by the hills.[12] Excavation in Guntturield artifacts which belong to Neolithic and Iron age periods. Sangam period antiquities were not collected. This site is also located between the hills.[13] Adhiyamankottai situated near Dharmapuri. This place may be the ancient Thagadue. So excavation was conducted by the Archaeological Department. Antiquities collected in this site is discussed in the third chapter. Sangam period antiquities were not collected in this site also. So this site is not the ancient Sangam period place.[14]

Modur a small village situated in the Western direction of Dharmapuri. Here also one excavation was conducted. Excavation details were discussed in the previous chapter. Modur was surrounded by the hills on three sides. The settlement area is about 40 acres. The hills are looks like a security walls around the place. It is mentioned in the Sangam literature.[15] Athiyaman were mentioned as the chiefs of the Kuthirai hills. One of these hills might have been the Kuthirai hill. The people discarded this place for unknown reason. Hence the name Kuthiraimalai is forgotten.

Modur was a ancient city. Neolithic people were settled in this place before 2000 B.C. In the excavation many verities of antiquities were collected.[16] Neolithic and Megalithic period potsherds were unearthed. Potsherds like black and red wear, red wear, black wear and russet coted wear were collected.

In addition to this brown slipped wear were also collected. They were collected in the surface as well as in the excavation. Large quantity of these wear were noticed in this site alone. No wear except Sangam period was collected in this site. Sangam period antiquities like terracotta earlobe, counch bangles, glass bangles and terracotta figurines were unearthed in this site. The ancient name of this area is called as Mandu. Mandu means ancient settlement area. Today also the local people called this area as Mandu. It is a ancient mound. The height of the mound is two meters. The excavation reveals that there was an urban center in the Sangam period.

In Sangam period many monuments like cairn circle, cist, dolmen and urn were erected in the memory of heroes who died in the battle. At Modur many megalithic burials were located. Among them two were excavated by the archaeologists. Many carnelian beads, iron objects, black wear, black and red wear pots and sarcophagus were unearthed in these burials. These antiquities are dated to the Sangam period. Two hero stones of Pallava period were also identified in this village. Two Sanniyasi stones are also standing this the entrance of the village. Every year rituals were performed to this stones for the health of the cattle. In those days' cattle is the main wealth of Sangam period. So these stones are erected in this village.[17]

Two inscriptions were copied from this village. The first inscription was vatteluthu script.[18] It mentions about the construction of a tank near this village and it is now also in use. The date of the inscription is 8-9th century A.D. It is located in the Northern side of the Modur village.

Second inscription was engraved on the boulder which is near the village. It was engraved during the Chola king Rajaraja III. It mentions Nigarilichola mandalam, Thagadur naduand Modur. Modur was donated as Dhavadana village to Singaperumal temple at Modur.[19] This inscription mentions this village as Moodur i.e. ancient city. It must be the correction form of the ancient Moodur. So one can conclude that Modur was the corrupt from of Moodur.

Modur excavation conform that there was a continuous settlement from Neolithic to Sangam period. From post Sangam period onwards it lost its importance. During the medieval period Nulambas captured Modur. After some time Thagadur might have been relocated to present Dharmapuri. There is no Sangam period antiquities and temples in present Dharmapuri. So with the help of above evidences Modur was the ancient Thagadur.

Prof. P.Shanmugam had studied the excavated Sangam age urban centers in Tamil nadu. He discussed about the location and area of the settlement in those days. Boundaries of the ancient site are also included in this discussion. Most of the settlements have the space between 40 to 50

acres. They had natural boundaries. For Kodumanal is also a Sangam period city. In this place there are two settlement areas. City and burial place were excavated. The settlement is is about 50 acres. This is one of the impotent trade cities in Tamil nadu. Here also there were no early medieval period settlements. Like this Modur is also one of the important cities in Sangam period.

A continuous settlement was found in Modur from Neolithic to Sangam period. After Sangam period there was no activation up to seventh century A.D. Nulambas controlled this region. On that time Nuambas might have been shifted the Thagadur to modern Dharmapiri. After shifting the capital to Dharmapuri they constructed new temples in Nulamba style. Before this there was no temple in Dharmapuri.[20]

Adhiyamans, during the Chola period ruled Dharmapuri upto Thirumali in Tiruvannamali district. Their inscriptions were also found Laddigam which is in Chittur in Andhra Pradesh. It shows that they ruled up to Andhra Pradesh. Two inscriptions were copied in Thirumali. Adhiyaman ruler renovated the Jain sculpture and reconstructed the Jain temple in Thirumali is mentioned in that inscription. Tamil inscription from the same place mentions Elini as the clan of the Vanciyar. (Chera)[21]

Sanskrit songs eulogized Adhiyaman as warrer of victories battle with Magadhas and Kadavas. It mentions about South Thagadur. (தென்தகடூர்) South Thagadur is mentioned in that inscription.So there must have been North Thagadur. (வடதகடூர்) Since Modur is in the northern direction of present Dharmapuri and it might have been the ancient Thagdur.[22]

Medival period Adhiyamans rule extened up to Tiruchangodu. One important message was found in the song and the song was given below.

> "சேரன்அதிகன்திருநெடுமால்தென்தகடை
> வீரன்விடுகாதழகியான்நேரவிருஞ்
> சேங்கோடுபோலச்சிலையைவடதிக்களவுங்
> கங்கோடவெட்டினான்கல்"

Adhiyaman, the Chera descendent who was in comparison with Thirumali. It also mentioned he was the ruler of the South Thagadur. (தென்தகடூர்) According to this song there was a city which was named as Then Thagadur. During Sangam period Thagdur was created which is attested by Sangam literature. In course of time another Thagadur was also created. Modur was the city of Sangam age. In medieval period present Dharmapuri was created as second Thagadur. During the Vijayanar period it was again changed a Dharmapuri.[23]

CONCULTION:

Before the Modur exaction period many historians and Tamil scholars identified that modern Dharmapuri was the Sangam period Thagadur. But after the excavation was conducted in

Modur archaeologist and scholars opine that Modur was the Thagadur of Sangam period, up to the end of the eighth century. After that the Modern capital was continued as Thagdur up to the thirteenth century. But there were no archaeological evidences in Dharmapuri.

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Women's activities towards family and social development

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Abstract

Women from past period to present period have been identified with multiple responsibilities in India's social system. Truly, all types of progress, development, improvement and moral characters of them are fostered by the their special endeavour in society, they dedicate most of their life time on children, family and husband development irrespective of any guilty and bias feelings because, they born to serve and save family system of entire society therefore entire society and family system is properly directed and conducted by their marvellous, thoughtful and trustworthy family development activities. Purity, spirituality, truthfulness and virginity are protected and thought to their children and family members with an aim to develop family system for make wholesome developments.

Due to the presence of female in every family is meant and understood as a family system because family is run and developed by them with a dedicated responsibility without namesake responsibility .They are being centre of family and children's future developments in an immaculate and systematic ways with an interest to protect their life in a much disciplined ways. Their presence in the society was understood many valuable and responsible creatures are made by the god. They are equalised and being parallel to the god exisistences thereby they must be respected and worshiped by all male peoples in all family system. Their role and presence are respected and welcomed by their children and family members for multiple and increase their family growth in all the aspects of future concern. Than male psychology, their psychology plays more vital role in terms of nurturing and fostering of children life, old aged people's life and family needs thereby they are felt and understood by all male that women are equal to god and more than god .From Initial to end of their life have been working and toiling lot comparing to male people because male people's strength will end their role up to forty five and fifty, even after that their responsibility is supported and backed by the female people. Men's work and age to work is calculated up to forty after that their role and family system is maintained and properly directed by women ,in this ways their conscious and moral role

is needed and wanted to the whole family system for conduct and run family member's life in a systematic and ethical ways .Beyond this no happy and merry to any one of family members ,altogether their positive role toward developing entire family member's life with a cemented and strong interests are considered as a positive and welfare making psychology of the women's characters.

Keywords: Role, Women Participation, Social system, Civics structure, male Role, Political awareness, Nation Development

Bearing Family's responsibility

After marriage of male and female in this civic society male's role remains up to certain age is meant logically up to 45, after this age he is addicted to alcohol, become inability, disinterested to work, roaming irresponsibly, to rectify these mistakes female will struggle lot once it seems to be impossible she will load all family issues and responsibility on her shoulder toward protecting family dignity and respects. From lower work to upper work and from small work to hard work is done by the female members without stop and leisure with an interest to save and nurture their children's life as well as family's virtuosity. This is not a phenomena is written in this paper merely and blindly it was written by author actually and really be seen directly all these habits of married male people in his villages herby female people are tortured ,met ugly situation and living uneasily since male people's role became absent .If there were whatever role from the female sections toward protect family system it would not be considered consummated and satisfactorily because male's cooperation and role is essential and necessary one which strengthens family situation and also protecting entire dignity of family members. Always family respects, virginity and responsibility is preserved and protected by the male people once it become absent it is undertaken by the female people with an aim to strengthen and sustain the family member's futures. In this circumstances children are suffering lot in the situation of family do not have male people and also expecting male's support and affectionate speech for their social protection and developments ,for this purpose female will advise to male people to give up all their vicious and bad habits ,once their request and advice is not understood by them family will fall in the pool of endless sorrow .Female will cry and found with sadness once their children are hopeless without supports of the male people in the civil society, for house maintenance and give responsibility to the children mothers role is enough but to carry out all types of masculine works male's role is indispensible therefore god gave both male and female

creature for carry out all types of this social and civil works ,in this regard male suppose to work hard with female people for accomplish family works for protect and make prosperous family member's futures needs and security.

Women's role is essential

Since this study has been embraced by so many stories and validated evidences of the male people 's absence in the family system female people are suffering lot ,toward this matter women are working lot and toiling sincerely for the children progress, family developments ,old aged people security ,look after husband and relatives relationships .This marvellous duty of them is appreciated ,lauded ,trumpeted and praised by the so many social and political scientist from western culture to Indian cultures. Family would be found incomplete and unpleased unless it has female presences ,in this contemporary world and period it is evidenced and revealed a woman would be able to achieve lot and run family without male's presence ,such capabilities and calibre they got due to their credible and enviable education qualifications and astute .This trend and phrase is evolved in the middle of so many people hearts due to male people addiction to lot of immoral habits and which was attempted to rectify by the female people across the global civil societies once it seems to be impossible they attempted to strengthen their personal calibre and capacity to strengthen family system and developments without leaning on male people support. Simply adamant and incompatible and indiscipline behaviours of the male people have been encouraged and motivated the female people to look after all types of civics works adventurously and actively so female role is going vertically while male role is going downward it is called as ascending and descending growth pattern.

Inculcating Political Awareness

In every family of Indian social system women were empowered by government special law, which has encouraged and motivated them to do all types of family and agricultural works. Their role in the present social system have been found lot and vast toward strengthening civic culture and social value, in this way their role in family developing, educating children, protecting family value, dignity and inculcating political education and political awareness have been contributed mammoth to be India's political development. In recent or contemporary Indian politics there are plenty of political awareness are increased lot due to women's systematic role in the family developments, their role regarding to casting vote, choosing right candidate, choosing good government, political party and establishing good society have been applauded by so many social

scientist and honoured by many rulers. In their social life they have been doing multiple munificent and mammoth social service and political service, than male people this women will be used to take care on whole family system thereby social development, civic integrity, knowledge development, education improvement, social awareness and increasing and inculcating political knowledge to their family members as to select good government have been as a routine job of them.

They do structured job for make good political system and Social System

SN	Women Role	Types	Gesture	Remarks
1	Running Family	Customary	Positive Activities	Socialism and nationalism
2	Caring Children	Customary	Positive Activities	Socialism and nationalism
3	Teaching Social and Political issues to their Children	Customary	Positive Activities	Socialism and nationalism
4	Imbibing Morality and Ethics	Customary	Positive Activities	Socialism and nationalism
5	Producing Responsible Citizen	Customary	Positive Activities	Socialism and nationalism

This table is illustrating about their responsible and customary role in the present conflictive social system of India, have been shining without fear and fearing to any host country's military threatening and attack due to an efficient women role in India's social and political fields thereby still India has been as one of the biggest democratic country as well as unshakable military power in the South Asian Continent.

Ethical society is created

From ancient period to prsent period womens are playing significant role in running family,educating childdern,imbibing morla stories to family membsr and reraring childern in a well structured and discplined ways ,it is fetcing proud and famous to their family from oppistie and negibour's family.This way is taking frawrd their family toward achiveing sucess and victory in their life duration and also makes shines their family from other familie's developments ,through this a village is developing ,a country is developing and good ad ministration is running therby mothers are daily telling good stories to their childern ,controilng them

not to wander uncessarily and go witth unknown persons in external fields becasue chidlern's behaviours and attiudes should be straightfowradr ,genuine and honesty for which they used to say that childern shoiuld family with good perosns and learn good stories for create an admirabble family system therein family mebers are able to travel and live with happiest mood and temperance. India's and civil society's good development and administration would be causes and production of the every house's woman role toward nurturing and developing their children in a useful ways therefore, women's role in India's civil society development is marvellous and significant one their welfare and development must be cared and protected by the state and central government's best and good polices.

Conclusion

Temple will not be as a temple unless it has priest and idol like this family will not be as a family unless it has responsible male and female people ,in this regard they have to work hard together and found coeternally and coexistence in terms to saving and nurturing family system. Entire society is generated and made by two people's presence their role must be existing ever since without gap and stop for the descendant progress and successor developments, by their mistakes innocent children and their defendant should not be harmed and spoiled so women role is priceless in the family system with that male people have to match and attach with them for make an amenable and accountable family system ,female would like to control means' characters and psychology with aim to make positive things and characters in all family system that must be understood by them and begin to be cordial and mutual with them without any misunderstanding and gossip .

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காலாண்டு இதழ்
(ஜனவரி, ஏப்ரல், ஜூலை, அக்டோபர்)
ஆகிய மாதங்களில் வெளிவரும்

ஆசிரியர் குழு

அரண் பன்னாட்டுத் தமிழாய்வு மின்னிதழில் வெளிவரும் ஆய்வுக்கட்டுரைகள் அனைத்தும் (Peer Review)பீர் ரிவியூ செய்யப்பட்டு பதிவு செய்யப்படுகிறது என்பதைத் தெரிவித்துக் கொள்கிறோம்.

நன்றி

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வரலாறு

உடுமலை பீரங்கி வார இதழ் - ஓர் ஆய்வு

முனைவர் ப. கற்பகவள்ளி
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ஆய்வுச்சுருக்கம்

இந்தியப் பத்திரிகை உலகில் 1948 க்கு முன்பு மிகவும் குறைந்த அளவிலான இதழ்களும் பத்திரிகைளும் வெளிவந்துகொண்டிருந்தன. அப்போதைய சூழலில் வெளிவந்த பத்திரிகைகளும், வார மாத இதழ்களும் பெரும் நகரப் பகுதிகளில் மட்டுமே அச்சிடப்பட்டு பொதுமக்களுக்குக் கிடைக்கக் கூடியதாக இருந்தது. ஆனால் உடுமலைப்பேட்டை போன்ற சிறுகிராமப் பகுதியிலிருந்து வெளிவந்த ஒரே இதழ் உடுமலை பீரங்கி மட்டுமே. இவ்விதழ் 1948- 1949 ஆகிய இரண்டு ஆண்டுகள் மட்டுமே வெளிவந்தது. ஆனால் , உடுமலை பீரங்கி என்ற பெயருக்கேற்ப இந்த இதழின் தாக்கம் பீரங்கியைப் போன்று அதிகமாக இருந்த காரணத்தினால் இரண்டே ஆண்டுகளில் இவ்விதழ் தடை செய்யப்பட்டுவிட்டது. இரண்டு ஆண்டுகள் வெளிவந்த வார இதழ்களிலிருந்து ஒரு இதழை மட்டும் எடுத்துக்கொண்டு அச்செய்திகள் இக்கால கட்டத்தோடு எவ்வாறு ஒத்துப்போகிறது? கிட்டத்தட்ட எழுபது ஆண்டுகளுக்கு முந்தைய இதழில் எவ்வாறு முற்போக்குச் சிந்தனைகள் மக்களிடையே விதைப்பதற்கு இவ் விதழ் காரணமாக இருந்தது என்பது குறித்த தகவல்களை இவ் ஆய்வுக் கட்டுரையில் பகிர்ந்து கொள்ள விரும்புகின்றேன். உடுமலை சிறு கிராமமாக இருந்தாலும் இவ்விதழுக்குத் தமிழ்நாட்டின் பல பகுதிகளிலிருந்தும் கட்டுரைகளும், சிறுகதைகளும், கவிதைகளும் பல பெரிய எழுத்து ஆளுமைகள் எழுதியுள்ளனர். உடுமலையைத் தலைமையிடமாகக் கொண்டு செயல்பட்ட உடுமலை பீரங்கி இதழ் சென்னையில் அச்சிடப்பட்டு அனைத்துப் பகுதிகளுக்கும் சென்றது. காலவோட்டத்தில் எழுபது ஆண்டுகளுக்கு முந்தைய செய்திகளாக இருந்தாலும் அதில் சொல்லப்பட்ட செய்திகள் அனைத்தும் இன்று வரையிலும் சமூக அரசியல் தளத்தில் பேசப்பட்டு வரக்கூடிய செய்திகளாகவே இருக்கின்றன என்பதுதான் இவ்விதழின் சிறப்பம்சமாகும். இவ்விதழை ஆய்வுக்குரிய கருவாக எடுத்துக்கொள்ளத் தூண்டியதும் இவ்விதழின் எழுத்தோட்டமும், எண்ண வோட்டமும்தான் என்றால் மிகையாகாது.

திறவுச் சொற்கள்: உடுமலை பீரங்கி, வார இதழ், முற்போக்குச்சிந்தனை

முன்னுரை

தமிழ்நாட்டிற்குப் பெருமை சேர்க்கும் பகுதிகளில் கொங்கு நாட்டிற்கு ஒரு தனிப்பெருமை உண்டு என்றால் அது மிகையாகாது. குறிப்பாக தென் கொங்கு நாடு பெருங்கற்காலம் முதல் ஆங்கிலேயர் ஆட்சிக் காலம் வரை ஒரு நீண்ட நெடிய வரலாற்றைத் தன்னகத்தே கொண்டுள்ள பகுதியாகும். இந்தியா 1947 ஆகஸ்ட் 15 ல் விடுதலை அடைந்தபின் 1948 மற்றும் 1949 என இரண்டு ஆண்டுகள் தமிழ்நாட்டில் பல புரட்சிகரமான கருத்துக்களால் ஒரு தாக்கத்தை ஏற்படுத்திய "உடுமலை பீரங்கி" எனனும் வார இதழைப் பற்றித்தான் இக் கட்டுரையில் காணப்போகிறோம்.

உடுமலை எஸ்.ஆர். ரங்கநாதன் என்பவரால் எழுதித் தொகுத்து வெளியிடப்பெற்ற ஒரு வார இதழ்தான் உடுமலை பீரங்கி. வெடி -1, குண்டு -18, என்று வெளிவந்து அக்கால கட்டத்திலேயே முதல் பக்கத்தில் ஆங்கிலத்திலும் *UDUMALAI BEERANGI* என்று இடம் பெற்றுள்ளது. அக்கால அரசியல் பொருத்தப்பாட்டுகளை கருத்துப் படங்களாகவே விளக்கும் வகையில் கார்ட்டூன் படங்கள் எனும் கேலிச்சித்திரங்கள் முதல் பக்கத்திலேயே அப்போதைய அன்றைய அரசியல் நிகழ்வை கண்ணாடியாகப் பதிவு செய்துள்ளது. இரண்டு ஆண்டுகள் வெளிவந்த இந்த இதழிலிருந்து 05.02.1949 வெடி 1, குண்டு -18 என்ற ஓர் இதழை மட்டும் என் ஆய்வுக் கட்டுரைக்கு எடுத்துக்கொண்டுள்ளேன். இது அக்கால கட்டத்தில் ஒரு அணாவிற்கு விற்கப்பட்டுள்ளது. மேலும் இந்த இதழில் தலைப்பிற்கு மேல் 'எல்லாரும் இன்புற்றிருக்க வேண்டும்"என்ற முழக்கத்தைக் கொண்டு வெளிவந்துள்ளது.

புரட்சிகரமான இதழ்

இந்த இதழிற்கு தமிழ்நாட்டின் பல பகுதிகளிலிருந்தும் முக்கியமான பல ஆளுமைகளிடமிருந்தும் சமூகம் சார்ந்தும் அரசியல் சார்ந்தும் கட்டுரைகள் வந்துள்ளன. மிக முக்கியமாகக் கருதப்படுவது பாவேந்தர் பாரதிதாசன் மற்றும் தந்தை பெரியார் ஆகியோரது கட்டுரைகளும் இதில் இடம் பெற்றுள்ளதுதான். எல்லா இதழ்களும் எட்டு பக்கங்களை உள்ளடக்கிய இதழ்களாக வெளி வந்துள்ளன. இத்தகைய புரட்சிகரமான கருத்துக்களைத் தாங்கிய ஓர் இதழ் 1949 ஆம் ஆண்டிலேயே உடுமலையிலிருந்து வெளி வந்திருக்கிறது என்பது உடுமலை வரலாற்றில் ஓர் முக்கியமான ஒரு பதிவு ஆகும். 1948 மற்றும் 1949 ம் ஆ;ண்டிற்குப் பின்னர் எக்காரணத்தினாலோ இந்த இதழ் தடை செய்யப்பட்டுவிட்டது. எதனால் தடை செய்யப்பட்ட என்பதற்கான தெளிவான சான்றாதாரங்கள் கிடைக்கப்பெறவில்லை. ஆனால் இந்த ஒரு இதழில் வெளிவந்துள்ள செய்திகளே

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போதும் எதனால் இவை தடை செய்யப்பட்டிருக்கலாம் என்பதை மறைமுகமாக உணர்த்துகின்றது.

முதலில் 05.02.1949 வெடி -1 குண்டு -18 இந்த இதழின் முகப்பில் வித்தியாசமான முறையில் கேலிச்சித்திரத்தை வெளியிட்டுள்ளனர். விடுதலைக்குப் பின்னர் எத்தயை சூழல் நிலவியது, மக்களின் தொழில்கள் எவ்வாறு பாதிக்கப்பட்டிருந்தது நேர்மையாக இருந்தவர்கள் , எவ்வாறு பாதிக்கப்பட்டனர் என்பன போன்ற நல்ல தகவல்களுடன் வெளிவந்துள்ளது

திரைப்பட நடிகை குறித்த திறனாய்வு

இரண்டாவது பக்கத்தில் 'நம்பினேன் உன்னை நடிகை ரம்பா" எனற் தலைப்பில் நடிகைகளுடைய மேக்கப் எப்படி இருந்தது., எந்தெந்த பொருள்களைப் பயன்படுத்தினர், அவர்களுக்கு எந்த அளவில் மரியாதை கிடைத்தது., பத்திரிகைகள் அவர்களை எவ்வாறு நடத்தின என்றும் சில பத்திரிகைகள் நினைத்தால் நடிகைகளை முன்னுக்குக் கொண்டு சென்று அவர்களை எப்படி உச்ச நட்சத்திரமாக மாற்ற முடியம் என்றும், இல்லையெனில் அவர்களுக்கு வாய்ப்பு கிடைக்காமல் கூட

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செய்ய முடியும் என்பதை இக்கட்டுரை விரிவாகவும் தெளிவாகவும் விளக்குகிறது. மேலும்:. அதே பக்கத்தில் 'சமுதாய பொதுமக்கள் சிநத்திதுப்பார்ப்பார்களா? ஏன்ற தலைப்பில் ஜெ.ராமகிருஷ்ணன் என்பவர் எழுதிய கட்டுரையில் தற்போதைய சூழலைமுன்பே கணித்து கட்டுரை எழுதியது போல் இருந்தது. இக்கட்டுரையில் எந்த வரிகளை தவிர்ப்பது, எந்த சொற்றொடர்களை எடுத்துக்கொள்வது என்றே தெரியவில்லை.

இதில் பிரிட்டிஷாரிடமிருந்து விடுதலை பெற்ற நாம் இன்றும் ' வடநாட்டு கொள்ளை லாபமடிக்கும் முதலாளிகளிடமிருந்தும், சமகத்தை பாழ்படுத்தி வைத்திருக்கும் வைதீகப் பித்தமும், போலி பக்தியும் கொண்ட சுயநலவாதிகளின் ஆதிக்கத்திலிருந்து இன்றும் விடுதலை அடையவில்லை" என்ற இக்கட்டுரை தொடங்குகின்றது. இது இப்போதைய சூழ்நிலைக்கு பொருந்துவதாகவும் உள்ளது. மேலும், " பஞ்சத்தினால் பாதிக்கப்பட்டு அவதுறயுற்றுத் தவிக்கும்போது, கடவுளின் பெயரால் நடத்தப்படும் கும்பாபிஷேகங்களுக்கும், உற்சவங்களுக்கும் பொதுமக்கள் பணத்தை விரயம் செய்வது, எவ்வளவு மதியீனம்" என்றும் இடம்பெற்றுள்ளது. ஜெ.ராமகிருஷ்ணனின் வரிகளை அப்படியே பகிர்ந்துகொள்ள விழைகின்றேன்.

'உலகத்தில் மானிடர் யாவரும் மண்ணாசை, பொன்னாசை, பெண்ணாசை, இம் மூன்றையும் நீக்கி உண்மை பக்தியுடன் கடவுளை பூஜிப்பவனே மோட்சம் அடைவான். ஆகையால் பொதுமக்கள், மோச்ஷம் அடைவதற்கு ஆண்டவனை அனுதினமும் பூசை செய்ய வேண்டும்" என்று ஊராருக்கு உபதேசம் செய்யும் மடாதிபதிகள், மறைவில் பெண்களுடன் லீலைகள் புரிந்து கொண்டும், பொதுமக்கள் பணத்தை வீண் விரயம் செய்தும், அட்டுழியங்கள் புரிந்தும் வருகிறார்கள். பொதுமக்கள் இவர்களை கடவுளின் மறு அவதாரம் என்றும் காலடிகளில் விழுந்து வணங்குகின்றார்கள். இந்த நிலை மாற வேண்டாமா? ஏன்ற கேள்வி கேட்கிறார். இது தற்போது நடப்பதை முன்பே கணித்துக்கூறியது போல் உள்ளது. பாடசாலைகள் ஏற்படுத்த பண உதவி செய்ய மறுப்பவர்கள் கோவிலைப் புதுப்பிக்கும் பணிக்கும், கடவுளின் வாகனத்;தைப் புணரமைக்கவும் தாராளமாக செலவு செய்கின்றனர் என்று சமூகத்தைச் சாடுகின்றார். மிக முக்கியமாக இந்த இதழின் மூன்றாவது பக்கத்தில்,' நபிகள் பிறந்த தின விழா" என்று குறிப்புச் செய்தியை கட்டம் போட்டு பதிவிட்டுள்ளனர். நபிகள் நாயகம் பிறந்த தினத்தை அப்போதைய நகரமன்றத் தலைவராக இருந்த தோழர் எம்.எஸ்.கனகராஜன் தலைமையில் பொள்ளாச்சி ரோடு, ரஹ்மானியா ரைஸ்மில் மைதானத்தில் மாலை ஏழு மணிக்கு கொண்டாடப்பட்டது. இதில் நபிகளின் வரலாறு, அவருடைய கொள்கைகள் பற்றியும் சொற்பொழிவாற்றினார்கள் என்றும் இடம் பெற்றுள்ளது. இதில் குறிப்பாக நாம் உற்று நோக்க வேண்டியது இந்து மதத்தைச் சார்ந்த நகர

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சபைத் தலைவர் , நபிகள் பிறந்த தினம் கொண்டாடுவதும், ஒரு நகரசபைத் தலைவரை , பத்திரிகைகள் தோழர் என்று 1949 ஆம் ஆண்டிலேயே அழைத்துள்ளது மிகவும் புரட்சி கரமானதாகும்.

இதே பக்கத்தில் மணி மருதன் என்பவர் எழுதிய மந்திரிகளும் மக்களும் என்ற கவிதையும் இடம் பெற்றுள்ளது. இதில் மந்திரிகளின் வாழ்க்கை முறையும் அவர்களின் வசதிகளும், பட்டியலிடப்படுகின்றது. பாமர மக்களின் நிலையும் மிகத்தெளிவாக ஒப்பிட்டுப் பதிவு செய்துள்ளார் மணி மருதன்.

உலக நடப்போடு உண்ணாவிரதம்

"உண்ணாவிரதம்" என்ற தலைப்பில் ஒரு சிறிய கதையுடன் கூடிய ஒரு நகைச்சுவைக் கலந்த ஒரு உரையாடல் இடம் பெற்றுள்ளது. ஒரு வக்கீல் தன் கட்சிக்காரர்களுக்கு கோர்ட்டில் எந்தக் கேள்வியைக் கேட்டாலும் "பே, பே" என்று பதில் சொல்லும்படி கூற அவர் புத்தி சுவாதீனம் இல்லாதவர் என்று நிரூபித்துத் தன் கட்சிக்காரரை வெளியே கொண்டு வருகிறார். நீதிமன்றத்தை விட்டு வெளியே வந்த அவரிடம் தன் ஊதியத்தை வக்கீல் கேட்டவுடன் , கட்சிக்காரர் சற்று உரத்த குரலில் "பே, பே"என இரண்டு கையை விரிக்கிறார். வக்கீல் ஊதியம் கேட்டு விவாதிக்கும்போது உனக்கும் "பே, பே" உங்கப்பனுக்கும் பே, பே, என்று சொல்லி திரும்பிப்பார்க்காமல் சென்றுவிட்டார். இந்தப் பழமொழி தற்போது கூட இன்றைய இளைஞர்களிடம் பரவலாக உள்ளது. ஆனால் இப்பழமொழிக்கு முன்னர் இத்தகைய நகைச்சுவை கதை இருக்கும் என்பதை இக்கட்டுரை வெளிப்படுத்தி உள்ளது.

இதே இதழில் 'நாட்டுப்பற்று" என்னும் தலைப்பில் சி.எஸ்.எம்.ஹபீப் என்பவர் எழுதியுள்ள கட்டுரையில் , சாதாரண பாமரனிடம் உன் நாட்டுப்பற்று எங்கப்பா? என்று கேட்டால் 'நட்டு வைத்த கத்திரிக்காய் செடிகள் அத்தனையும் கருகிவிட்டது. கம்புக்கொல்லையில் பக்கத்து ஊர் வம்புக்கார மாடுகள் வந்து மேய்ந்துவிட்டது என்று கூறுவான் அவ்வளவதான் அவனுக்குத் தெரியும். அது அவனுடைய குற்றமில்லை. அவனுக்குக் கல்வி அறிவு தரவேண்டியது யாருடைய கடமை, தமிழராட்சி தலைத்தோங்க வேண்டும். தன்னிகரற்று தமிழ் கல்வி பரவ வேண்டும் என்ற கொள்கை ஒவ்வொரு தமிழரது மனதிலும் உதிக்க வேண்டும். 1949 ஆம் ஆண்டு வெளி வந்துள்ள ஓர் வார இதழிலேயே இவ் வாசகங்கள் இருப்பது கிட்டத்தட்ட 72 ஆண்டுகளுக்குப் பின்னர் தமிழ் தெரியாத தமிழர்கள் எண்ணிக்கையில் அதிகமாக வருவார்கள் என்று முன்னமே அறிந்து கூறியுள்ளது போல் உள்ளது.

'மறைந்த மாவீரர் சிந்திய ரத்தம்" எனும் தலைப்பில் நாகை இரா. மணவாளன் என்பவர் எழுதிய கட்டுரையில் மதம் என்ற ஒன்று இல்லை. சத்தியமும் தர்மமுமே உண்மையான மதம் என்றார். உத்தமர் காந்தி உண்மையைத் தவிர உயர்ந்த மதம் வேறு ஒன்று உண்டா"? என்று கேள்வி எழுப்பியவரை மதத்தின் காரணமாகவே கொன்றுவிட்டனர் என்று தன் மனக்கொந்தளிப்பை வெளிப்படுத்தி உள்ளார். மேலும் நம் நாட்டில் 200 ஆண்டுகளாக அந்நிய மதங்களும், அரசுகளும் இருந்தை அகற்ற எத்தணித்தோம். நினைத்த மாத்திரத்திலேயே போர் போர் நடந்தது என்று இதற்கு யார ;குற்றவாளி? மதவாதியா? புரோகிதரா? வைதீகர்களா? சுயநலவாத அரசியல்வாதிகளா? இவற்றால் நாம் அடைந்த பயன் என்ன? நம் அறிவும் ஆண்மையும் எதற்குப் பயன்படுத்திக் கொண்டு இருக்கிறோம்? என்ற ஆதங்கத்தையும் அப்போதே வெளிப்படுத்தி இருக்கிறார். இந்த ஆதங்கம் இன்றைய சூழலுக்கு மிகப்பொருத்தமாய் உள்ளது என்னை வியப்பிற்குக் குள்ளாக்கியது.

அடுத்த கட்டுரையாக 'அங்கும் இங்கும்" என்ற தலைப்பில் உடுமலை எஸ். ரசாக் என்பவர் எழுதிய கட்டுரை ஆகும். இத்தலைப்பில் அங்கு என்று அமெரிக்காவையும் இங்கு என்ற தமிழ்நாட்டையும் மிக ஆழ்ந்த ஒப்பீட்டுக்குள்ளாக்கி மிக அரிய கருத்துக்களைப் பகிர்ந்துள்ளார். ஒப்பீட்டை நோக்கியே பல கருத்துக்களில் இன்றும் என்றும் பொருத்தமாகத் தோன்றக்கூடிய சில கருத்துக்களை மட்டும் பகிர்ந்து கொள்கின்றேன். 72 ஆண்டுகளுக்கு முன்னரே அமெரிக்காவைப் பற்றியும், அங்கு நிலவும் பழக்கவழக்கங்கள், சட்டங்கள் ஆகியவை பற்றியும் சிறு கிராமப்புறமான உடுமலையைச் சார்ந்த ரசாக் அறிந்திருந்தது மிகுந்த வியப்பிற் குள்ளாக்கியது.

1.   அமெரிக்காவில் அமேசான் நதியில் தன் உடல் அழுக்கைப் போக்க குளிக்கிறான் .

இங்கு காவிரியால் தன் பாவத்தைப் போக்கக் குளிக்கிறான்.

2.   அங்கு விமானம் மூலம் உலகம் சுற்றும்போது இங்கு அரச மரத்தையும் கருங்கலையும் சுற்றுகிறார்கள்.

3.   அங்கு பகுத்தறிவு வளரும் வகையில் பாடத்திட்டங்கள் உள்ளன, இங்கு புராணங்களே பெரும்பாலும் பள்ளிப்பாடங்களாக உள்ளன.

4. அங்கு சந்திரமண்டலத்தில் போய் சோதனை நடத்துகிறார்கள். ஆனால் இங்கே சந்திரனை சாமியாகப் பாவித்து வழிபட்டு வருகிறார்கள்.

5.   அங்கு விதவைக்கு மறுமணம் உண்டு, ஆனால் இங்கு விதவைக்கு ரணம் நிச்சயம் உண்டு.

6. அங்கு மழை பெய்வில்லையென்றால் செயற்கை மழையைப் பெய்யச் செய்கிறார்கள். ஆனால் இங்கு வருண பகவானுக்கு பூசை செய்கிறார்கள் என்று குறிப்பிட்டுள்ளனர். தமிழ்நாட்டு மக்கள் எத்தகைய மூடநம்பிக்கைகளுக்கு முக்கியத்துவம் கொடுத்து வந்துள்ளனர் என்பதை இந்த இரண்டு வரிகள் தௌ;எத் தெளிவாக விளக்குகிறது.

7. மிக முக்கியமாக அங்கே தாய்மொழிக்கு மதிப்பு உண்டு, ஆனால் இங்கே லம்பாடி மொழிக்கு பெருமதிப்பு உண்டு என்று பழமையான தமிழ் மொழியின் மதிப்பை ஏற்றுக்கொள்ள மறுக்கும் வடமாநிலத்தவரின் எண்ண வெளிப்பாட்டை பிரதிபலித்தார்.

தற்போதைய கீழடி ஆய்வு தமிழின் தொன்மையை உலகிற்கு பறைசாற்றினாலும் அதை ஏற்க மறுத்து சமஸ்கிருதத்தை முன்னெடுப்பவர் களாகத்தான் வடமாநிலத்தவர் உள்ளனர்.

சாதி பற்றிய முற்போக்குப் பார்வையில் ஒரு சிறுகதை

இதில் கடைசிக் கட்டுரையாக ஓர் காதல் சிறுகதை தா. மதுரதாசன் எழுதிய, 'நான் விரும்பிய நங்கை எனும் தலைப்பில் அது சாதிவெறியும், ஆணவக்கொலைகளும் ஆக்கிரமித்து இருந்தது என்பதை பறைசாற்றுவதாக இருக்கிறது. காதல் ரசம் சொட்டச் சொட்ட தொடங்கிய சிறுகதை வருணனையில் "கருகிய கூந்தல் அலைய மயக்கும் கண்கள் கீழ் நோக்க இடையில் மண்குடம் இருக்க, அசைந்தாடும் அன்னம் போல் வந்து கொண்டிருந்தாள் என்தேவி " என்று செல்கிறது.

'எங்களைத் துன்பத்தில் ஆழ்த்தியது சாதி என்னும் சாத்திரமும், துன்பத்தில் ஆழ்த்தியது ஏழை என்ற பொருளாதார பேதம் என்றனர். எப்போதும் போல் தேவியைக் காணச் சென்றேன். கதவு மூடப்பட்டு இருந்தது. நிசப்தம் நிலவியது. திகைத்தேன், கற்சிலை போல் நின்றேன், அன்பெனும் திரையில், காதல் எனும் ஓவியம் தீட்டினேன். அது சமூகமென்னும் கத்தியால் சாதி வெறி என்று கூறிய முனையால் கிழிக்கப்பட்டது என்று நான் விரும்பிய நங்கை என்ற சிறுகதையை முடிக்கிறார்.

தற்போதைய காலகட்டத்தில் இருக்கக்கூடிய சாதி வெறி, ஆணவக்கொலை போன்றவற்றிற்கு அப்போதே அடித்தளம் இருந்துள்ளது. அதை உடுமலை பீரங்கி போன்ற இதழ்களும் பதிவு செய்துள்ளது என்னை வியப்பில் ஆழ்த்தியது. நான் ஆய்வுக்கட்டுரைக்கு எடுத்துக்கொண்டு ஓர் இதழிலேயே இத்தனை புரட்சிகரமான கருத்துகளும் தமிழ்நாட்டின், இந்தியாவின் தற்போதைய சூழ்நிலையையும் 72 ஆண்டுகளுக்கு முன்பே தௌ;எத்தெளிவாக எடுத்துரைத்த ஓர் காலக்கண்ணாடியாகத்தான் உடுமலை பீரங்கி தோன்றுகின்றது.

இதழின் கடைசிப் பக்கத்தில் பிபியார் என்பவரின் 'லட்ச ரூபாய் நட்சத்திரம்" என்ற தலைப்பில் அப்போதைய புகழ் பெற்ற கே.பி. சுந்தராம்பாள் அவர்களின் திரை உலக அனுபவங்களைத் தொடர்கதையாக எழுதி உள்ளார். அன்றைய கால கட்டத்தில் இந்திய அளவில் ஒரு லட்சம் ரூபாயை ஊதியமாகப் பெற்ற முதல் தமிழ் பெண் நடிகை என்ற பெருமைக்குரியவர் இவரே.

இவ் இதழில் சிறு சிறு விளம்பரத் துணுக்குகளும் இடம் பெற்றுள்ளன.

ஒரு பானை சோற்றுக்கு ஒரு சோறு பதம்

ஒரு பானை சோற்றுக்கு ஒரு சோறு பதம் என்பது போல் இரண்டு ஆண்டுகள் வெளிவந்த இந்த இதழுக்கு இது ஒரு இதழே உதாரணம் என்றும், மேலும் எத்தகைய பிரச்சினைகளால் இந்த இதழ் வெளிவருவது தடை பெற்றிருக்கக்கூடும் எனவும். நம்மால் யூகிக்க முடிகிறது. எனவே, இத்தகைய சீர்திருத்தம் மிக்க புரட்சிக்கருத்துக்கள் உடுமலையிலிருந்து தமிழ்நாடெங்கும் பெரும் வரவேற்பைப் பெற்றுள்ளது என்பது மிகுந்த பெருமையை அளிக்கிறது. இந்த இதழுக்குக் கட்டுரைகளும், கவிதைகளும் தமிழ்நாட்டின் பல பகுதிகளிலிருந்தும் வந்துள்ளது. உதாரணமாக பாபநாசலம், தூத்துக்குடி, செங்கற்பட்டு, ஆத்தூர், சேலம், சிங்காநல்லூர், கோவில்பட்டி, டவுன் நீலகிரி, சென்னை, புதுவை என அனைத்துப் பகுதிகளியிருந்தும் வந்துள்ளது. ஒரு சிற்றூரில் இருந்து வெளிவந்த வார இதழுக்கு அனைத்து இடங்களிலும் வரவேற்பு இருந்துள்ளது. மேலும் உடுமலையைத் தலைமையிடமாகக் கொண்டிருந்தாலும் இந்த இதழ் சென்னையில்தான் அச்சிடப்பட்டுள்ளது என்பது மிகுந்த வியப்பையும், பிரமிப்பையும் ஏற்படுத்துகின்றது.

அப்போதைய கால கட்டத்தில் கூட பத்திரிகைகள் எழுதத் தயங்குகிற பல தகவல்களை 1949 ஆம் ஆண்டிலேயே வெளியிட்டு ஒரு எழுத்துப்புரட்சியை ஏற்படுத்தியுள்ளது என்றால் அது மிகையாகாது. இத்தகைய இதழ் குறித்து ஓர் ஆய்வுக் கட்டுரை எழுத வாய்ப்புக்கிடைத்ததும் அதன் மூலம் வெளிவந்துள்ள தகவல்கள் அனைத்துமே 72 ஆண்டுகளுக்குப் பின்னரும். இன்றைய காலகட்டத்திற்கும் அனைத்தும் பொருந்துவதாக அமைந்துள்ளதே உடுமலையின் பீரங்கியின் சிறப்பம்சமாகும்.

<u>முதன்மைச் சான்று</u>

'உடுமலை பீரங்கி" வார இதழ் மெய்மம் நகல் (ஒரிஜினல் காபி)

<u>துணை ஆதாரங்கள்</u>

'திராவிடம் வளர்த்த தமிழ்" கட்டுரை ஆசிரியர், தனுஷ். தலைப்பு : உடுமலை பீரங்கி, மணி அச்சகம், சென்னை. 2019, ISBN : 978-93-89182-03-3

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கட்டுரை வந்து சேர வேண்டிய கடைசி நாள் அக்டோபர் - 10. அதற்கு பின் வரும் கட்டுரைகள் ஜனவரி இதழில் இடம்பெறாது என்பதை தெரிவித்துக் கொள்கிறோம்.

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Abstract:

Women welfare schemes have been introduced in the economic, political, social, educational, employment and health filed for the upliftment of poor women folks in rural and urban areas and for the empowerment of their families. Women welfare branches, Women service homes, Hostel for working women, Mahalir mandram, Work Centers and production units, Widows rehabilitation, Education and Employment opportunities, Women participation in social and political spheres, self-Help Groups etc. are the measures supporting the women to achieve their financial, political and social needs. The aim of this study is to highlight the opportunities offered by Government and Non Government Organizations.

The well-being of women and health are the real index of a society and the nation. The progress of the nation largely depends upon the progress of women and the well being of the children. The D.M.K. Government conducted detailed discussions for the successful implementation of the welfare programs for women empowerment. The Women Welfare Department of the Government of Tamil Nadu was established in 1947[1]. In 1958, the Panchayat Act was introduced by the Government of Tamil Nadu[2]. The three agencies, viz. the Women's Welfare Department, the State Social Welfare Board and the Women's Welfare Wing of the Department were integrated into a single and unified Department of Women's Welfare in 1961.

Introduction:

The Tamil Nadu Government has articulated comprehensive policies for the empowerment of women through a variety of instruments and approaches focusing on an explicit vision of equal partnership of women in all walks of life. Tamil Nadu spreads the pre-Aryan Dravidian Culture in India dating back to 6000 years. Great women poets and thinkers were in high reference in Tamil literature. The status of women in Tamil Nadu evolved down centuries with ups and downs and a lot more remains to be done in enhancing the same. The year 1917 was significant for many reasons. The important one is the formation of Women's India Association (WIA)[3]. This association was started at Adyar, Madras on 8th May 1917. The presence and leadership of the Mrs.

Annie Besant Provided an impetus to Women to think in terms of political freedom[4]. They also supported to compulsory primary education for girls and Hindu Women's inheritance laws[5].

Women Welfare Schemes

Women's Welfare Branches: There were many welfare branches in the State during the Congress rule in Tamil Nadu. The women were convened to get training in useful crafts like tailoring, mat making, embroidery, basket making, leaf plates making, etc., Each branch had twenty to thirty women members[6]. These branches started with low income. An approximate sum of Rs.7000/- was spent per branch per annum.

Women's Service Homes: The second most important social welfare work was undertaken by the Department of Women's Welfare. Service Homes were run by the Department of Women's Welfare. The first Service Home for Destitute Women was started in 1948, at Tambaram, a separate section was run for the physically handicapped women[7]. These homes functioned during D.M.K. Administrations[8]. The Central Social Welfare Board looked after it through the State Social Welfare Advisory Board, Madras. In These Services Homes, destitute Women of the age group of 18-35 years were taken in[9]. Each Service Home contained one tailoring unit, and a Secondary Grade Teacher's Training Course. The women were given coaching for the E.S.L.C. Examination or Technical Examinations in needle work, embroidery, dress making or mat-making and S.S.L.C condensed course with the assistance of the State Social Welfare Board[10]. Women, who were interested in tailoring, were trained for Tamil Nadu Technical Examination. In Tambaram Service Home, there were two special wings functioning one for the handicapped women and another wing established in 1973 for manufacturing readymade garments[11].

Hostel for Working Women: The lower middle income group women who worked for a living away from their homes and parents found it hard to find accommodation. So the Government to meet this problem decided to run hostels for working women. They also assisted the voluntary institutions, which ran hostels through grants in aid scheme of the Board. A hostel was founded in 1967, in Egmore. Its sanctioned strength was twenty five and the annual expenditure amounted to Rs.25,000/-[12]. The Government also proposed to encourage and support voluntary institutions, which run hostels for working women and proposed to give grants-in-aid for putting up their own buildings.

Mahalir Mandram: This program was devised to organize women of rural areas together in Mahalir Mandram, regardless of socio-economic barriers. For this purpose, 13,124 Mahalir Mandrams were started at the rate of one for each Panchayat. Mahalir Mandram discussed with the

local women on various subjects of interest and utility like child care practices, household arts, home economics, kitchen gardening, health, environmental sanitation, etc.

10082 Mahalir Mandrams were equipped with sewing machines and Craft Instructresses were appointed by the Panchayat Unions and the local women taught to stitch simple garments[13]. A total of 1076 Mandrams were registered under the Companies Act and some of them had become eligible to get grants in aid from the State Social Welfare Board as voluntary institutions. Institutional Training facilities were made available for training women in the rural extension centers. The women were encourages to engage themselves in some socio-economic programs like dairying with the grants received from the State Social Welfare Board. To encourage Mahalir Mandram and to undertake different types of economic activities for the welfare of women, cash awards of Rs.1000/- Rs.600/- and Rs 400/- were made. This scheme was aided by the centre.[14]

Work Centers and Production Units: Under the socio-economic program, the Department of Women's Welfare during the second phase started work centers and production units and in the III Five Year Plan period for Scheduled Castes, Scheduled Tribes and Denotified Tribal women with funds from the Harijan Welfare Department. The main aim of these work centers was to impart intensive training to socially and economically backward women to enable them to supplement their income through these crafts. In 1975, thirty one work centers and eight production units were functioning throughout the State. About 4000 women were benefitted through the above schemes and the annual expenditure for these centers was Rs.0.26 lakhs. Some of the special groups of women were also helped by the Social Welfare Department. They were the Burma Repatriates, Ceylon Repatriates, Harijan Women, Ex-Service men and Teacher's families. Further, the Department of Women's Welfare also conducted yearly exhibitions through which the activities of the Social Service Department were exposed to the public. These exhibitions also served the purpose of managing to sell the products manufactured by the work centers, production units and the service homes.

Widow Rehabilitation: Widow remarriage was encouraged by presenting incentives in the form of National Certificate to both husband and wife to the value of Rs.5,000/- to be held-in deposit for seven years. The scheme was restricted to destitute widows, in the group of 18-30 years. This Scheme was introduced on the 52nd birthday of M.Karunanidhi, the then Chief Minister (1975) of Tamil Nadu. During the year, 1975-76, 92 couples were provided with financial assistances amounting to Rs.4,60,000/-[15]. Further, under this Scheme, one thousand sewing machines were presented to thousand destitute widows in the age-group of 18-45, who had been trained in tailoring in the institutions run by the Government or other recognized private institutions. "Destitute widows above forty years of age were given pension of about Rs.20/- per month. In the rural textile

centers about 279 destitute widows were enrolled and trained. Further Rs.2.79 lakhs was allotted to provide training for the destitute widows.

Education and Employment Opportunities for women

During 1967-68 the number of High Schools for Girls was thirty six Government Schools, ninety four District Board Panchayat Union Schools, thirty four Municipal Schools and one hundred and eight Aided Schools. The total strength of girls in these schools was 5,30,440. The policies of the state Government and other educational facilities such as Mid-day Meals, free uniforms, free schooling up to S.S.L.C, Scholarships for the Scheduled Castes, Scheduled Tribes and economically backward students promoted women's education.

Women Participation in Social and Political Spheres

The 73rd and 74th Constitutional Amendments have provided ample scope for women to participate in development activities undertaken by the local bodies. One-third of the members of Local Bodies are women including SC and ST. It is worth mentioning that the Reservation Policy allocating 30 percent of the seats for women to Legislature and Parliament would give a much-needed shot in the arm for the women. Entrepreneurship can help women's economic independence and improve their social status. Automatically, the women get empowered once they attain economic independence. The development of women entrepreneurship enables society to understand and appreciate their abilities, it enhances their status and leads to integration of women in nation building and economic development. Over the years, more number of women going for higher education, technical and professional education and their proportion in the labour force has also increased.

With the spread of education and awareness, women have shifted from the extend kitchen, handicrafts and traditional Cottage Industries to non-traditional higher levels of activities. During the 1970s, the decade of the International Women's Year, efforts to promote self employment amount women received greater attention from the Government and private agencies. The new industrial policy of the Government of India had laid special emphasis on the need for conducting special entrepreneurial training programs for women to enable them to start their own ventures[14].

Self Help Groups in Tamil Nadu: Under the Eighth Five Year Plan, special programs for women have been implemented to complement the general development programs. These women specific programs have given emphasis on generation of employment, awareness and increase in health facilities. Women have been enabled to function as equal partners and participants in the development process.

This approach on the Ninth plan commitment to the objective of "Empowering Women as the Agents of Social Change and Development". It has focused on empowering women by making

women economically independent and self-reliant[17]. It is to be noted as an example of empowerment of women by welfare scheme, that Mrs. Lakshmi, a member of "Elumaliayan Mahalir Self-Help Group" at Vayalur in Kanchipuram District of Tamil Nadu, obtained a interest free loan of Rs.3 Lakhs, from "Nuntholil Membattu Thittam" Bank loan of Rs.99,000/- and her share capital was Rs.72,500/- for "Hallow Block" making business. On 12.12.2013, she started business in the name of "Living Stone Hollow Block". The total turnover of the business is Rs.72,25,642/- and she earned a profit of Rs.3,07,500/-. With this income, her two sons completed the B.E., Degree. In additional to this, for business purpose, she purchased a lorry. Now she became the owner of her own business and the empowered women for her family because of this SHG Women Welfare Scheme.[18]

Conclusion: As we all know that India is a male dominated country where males are dominated in every area and females are forced to be responsible for only family care and live in the home including other many restrictions. Almost 50% of the population in India is covered by the female only so the full development of the country depends on the half population means women, who are not empowered and still restricted by many social taboos. In such condition, we cannot say that our country would be a developed in the further without empowering its half population means women, If we want to make our country a developed country, first of all it is very necessary to empower women by the efforts of men, government, laws and women too.

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"PROTECTION OF RIGHTS OF WOMEN:- GLOBAL SCENARIO AND INDIAN CONTEXT"

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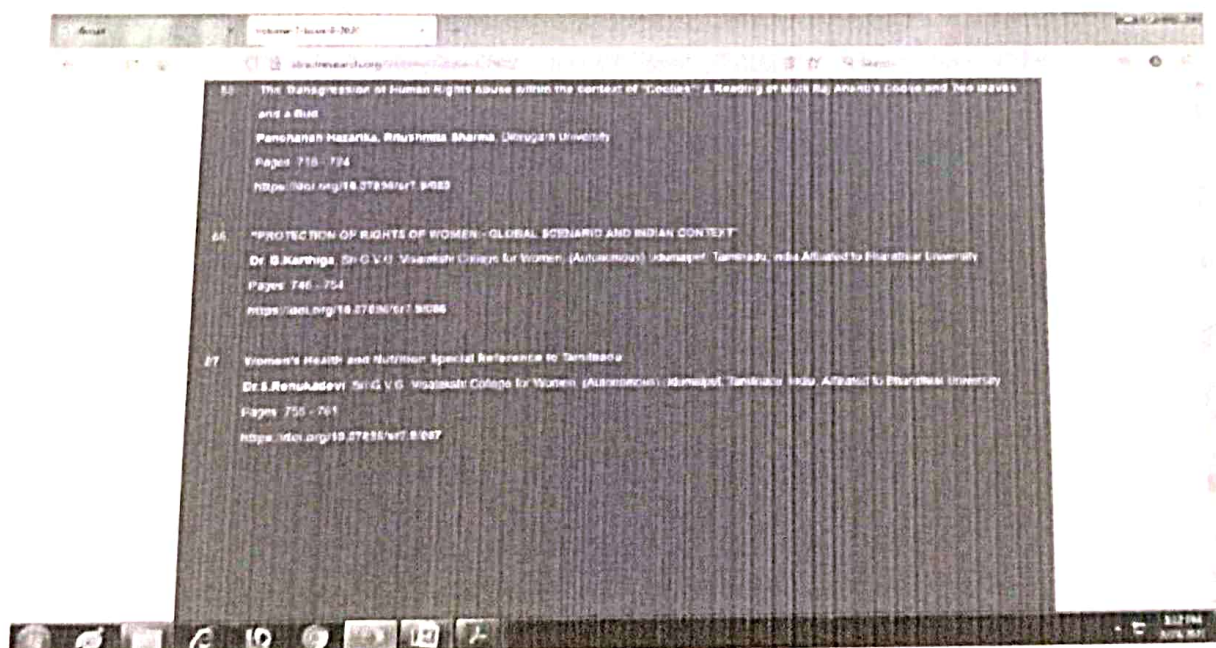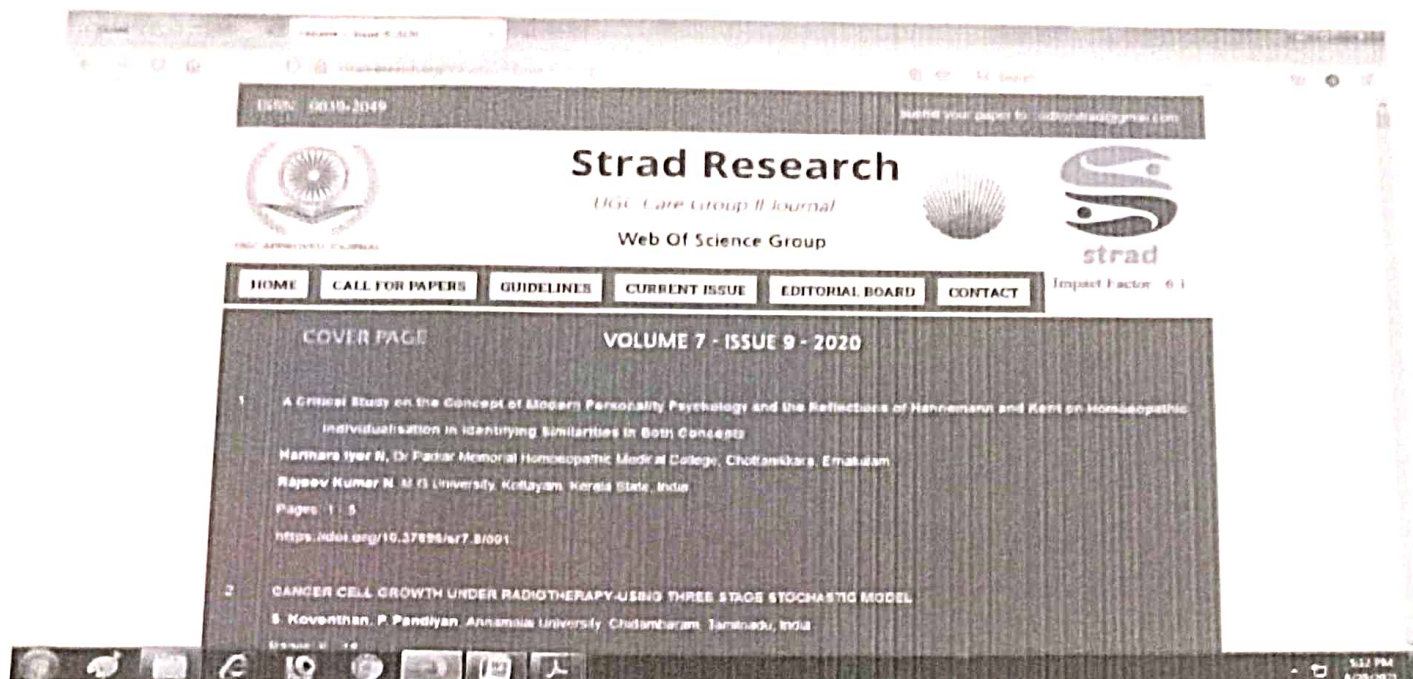
"PROTECTION OF RIGHTS OF WOMEN:- GLOBAL SCENARIO AND INDIAN CONTEXT"

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OBJECTIVES:

The objectives of this paper on "Protection of Rights of women:- Global Scenario and Indian Context" are

i)   To understand the rights of man.

ii)   To examine the meaning of Human Rights.

iii)   To analyse the rights of women

iv)   To know the efforts taken to ensure Human Rights in the global scenario.

v)   To assess the rights of women enshrined in the Indian constitution and various laws enacted for the cause of women talk and their rights.

1.INTRODUCTION:

A Rights may be defined as something to which an individual has a just claim. According to Habhouse, "Rights are what we except from others and what they expect from us". Human Rights are those that individuals have by virtue of their existences as human beings. They are the rights; one has simply because one is a human being[1]. The right to life itself and the basic necessities of foods. shatter. clothing. education and health may be considered fundamental Human Rights. These Rights are inherently belonged to a person[2]. It affirms his

human dignity one enjoys the Human. Rights by birth. These rights shall be guaranteed by the Government, by the constitution and by the laws. Everyone shall have the privilege, basically to enjoy these rights, irrespective of nation or other differences[1]. An individuals rights, when accepted by the society, they become the Human Rights. Without rights, man cannot live or develop.

Roussean[4], "the Father of Revolutions" stated in his magnumompus,"the Social constaret[5], that man is born free and everywhere he is in chains[6]. Human Rights are now the "Common language of humanity".

Rights are born with the birth of man, sometimes its origin even before birth. It originates in the womb of woman. Foeticide is one of the serious crimes, committed by parents (or) mother or father. This is the order of the day, not only in Usilampatti and Dharmapuri, but also in Tamil Nadu and India. This problem is wide spread all over the world. Female foeticide is one of the serious and thought provoking crimes all over the world.

Human Rights are the inherent rights of man. They are the rights of men and women[7], baby and infant, adult and adolescent. All human beings are born free and equal indignity and rights[8]. Even though Human Rights are equal to all human beings, they differ from nation to nation[9]. Women's Rights are the rights of women. They are the exclusive and specific rights of women. It emphasises women as human being. Full equality between men and women shall be ensured and established.

About the rights of women were not spoken much in yester years, but now more are spoken about Human Rights and more specifically the Rights of women. Of course, after the two world wars more was spoken about Human Rights, because of the havocs of the world wars

were so harsh. In the world level, women were victimised in various spheres. As far as India is concerned, women went through innumerable and inhuman social implications and it complicated and questioned the rights, the basic rights of women. The social evils faced by women in the past, and sometimes in the present, were sati, child marriage female infanticide, female foeticide, dowry system, prohibition of widow remarriage, devadasi system, polygamy, Jauhar System, etc.,

The Rights of Women shall be protected at any cost. Violations of Women's Rights are quite common. Very often the Rights of women are violated in the name of religion, caste, creed, colour, and race, place of birth and so far and so forth. No doubt, western education and western culture created some sort of awareness directly or through social reformers like Raja Ram Mohan Roy, Mrs. Annie Besant, sister Nivedita, Sarojini Naidu, Mother Theresa, etc.,

Women shall enjoy the same rights as men in all respects. Their rights shall be promoted and protected. Mahatma Gandhi once said, "The development of women is the development of a nation". If a woman is educated, a family is educated.

2.GLOBAL SCENARIO:

Article II of the Universal Declaration of Human Rights[10] speaks like this "Everyone is entitled to all rights and freedom set forth in this declaration, without distinction of any kind such as race, colour, sex, language, religion, political or other opinion, national or social origin, property, birth or other status[11]. Thus this provision guideline for general action against discrimination on the ground of sex and in matters related to the status of women in general[12]. The General Assembly of the UNO at its IX session dealt with the status of women in private

law, customary, ancient laws and practices affecting the human dignity of women[13]. We understand that the world community is always aware of the rights of women.

Article 26 of the International Covenant on Civil and Political Rights. Provides that all Persons are equal before the law. All are entitled to the equal protection of the law of the land. Here the law shall prohibit any discrimination and guarantee to all people equal and effective protection against discrimination in the name of race, sex, colour, religion, language, political or other opinion. National or social origin, property, birth or other status[14].

The Economic and social council of this UNO established a sub commission to enquire into the status of women. The council in its resolution 48(IV) defined the functions of the commission. Its function included promoting Women's Rights in Civil, Political, Economic, Social and Educational fields. It will also make recommendations to the Council on urgent matters and problem requiring immediate attention in the field of women's Rights with the object of implementing the principle that men & women shall have equal Rights[15].

3. INDIAN CONTEXT:

Male chauvinism is one of the important problems Indian women face. Despite, westernization and spread of western culture, education, science and Technology that had created a lot of changes in the society, still Indian women are in chaos, confusion and in darkness. The endeavours enunciated by the British especially Lord William Bentinck[16] and RajaRam Mohan Roy resulted for passing the Sati Prevention Act 8n 1829. This Act prohibited the custom of burning Hindu widows alive in the funeral pyre of their husband. But unfortunately this cruel and evil practice was vague among certain orthodox Hindu families still recently. More seriously, the Government of India enacted the sati prevention Act in 1987 to put an end to this

inhumanitanian crime and practice. During the British regime, Child marriage Restrained Act was also passed in 1929 to prevent the early marriage of girls in tender age, but this practice still persist in certain parts of the country[17].

The Republican constitution of India contains a lot of provisions to ensure the rights of the women. Article 38 speaks of the welfare of women in matters relating to justice, political, social & economical. Article 39 insists the citizens; men and women equally, have the right to an adequate means of livelihood. This Article facilitates for equal pay for equal work for both men & women. The Hindu Marriage Act of 1955, for the first time, gave the right to women to get divorce of her husband. This Act also provides that a second marriage during the life time of the first wife as illegal. Under this Act, a women is eligible to get maintenance permanently, still she enters to remarriage. The right of remarriage of widow is also provided in this Act[18].

Dowry prohibits Act of 1961 giving dowry or taking dowry in cash or any form. Amendment was made in section 304-V of IPC (Indian Penal Code) by the Act 43 of 1986. The Hindu succession Act of 1956 recognised widows rights to property. Muslim women protection of Rights on Divorce Act of 1986 provides a Muslim divorce to claim maintenance only for Iddat period three months after pronouncing Talaque[19].

The Hindu succession Act of 1956 recognised the right of Hindu daughters. This Act also paved the way for a Hindu widow to become the sole owner of the property left by her deceased husband. Muslim law also provides wife and daughters, the right to own property, inherit the share of husband's as well as the father's property. Despite, plenty of clauses in the constitution and legal measures, it has become a routine news in the dailies and magazines that women undergo a number of problems due to the crimes committed against her in one way or other. Male chauvinism still persists in the society very commonly. Illiteracy is the main reason

for all these misdeeds. Even after 71 years of Indian Independence and even after 70 years of Universal Declaration of Human Rights, it is really unfortunate that women take are still treated as sexlust for males[20].

4.CONCLUSION:

Human Rights are the rights of men and women. The rights of women are exclusively their rights. Full equality between men and women are insisted. The universal Declaration of Human Rights insists for equality between men and women Article 26 of the International covenant of Civil and political Rights provides that all person are equal before the law. Indian constitution in its various articles speaks of the equality between men and women.

The child marriage Act of 1929, Sati prevention Act of 1987, Hindu marriage Act of 1955, Hindu succession Act of 1956, Dowry Prohibition Act of 1961, etc., speak of the rights to be given to the women folk let us old think of ensuring the equal rights to be enjoyed by the women folk always.

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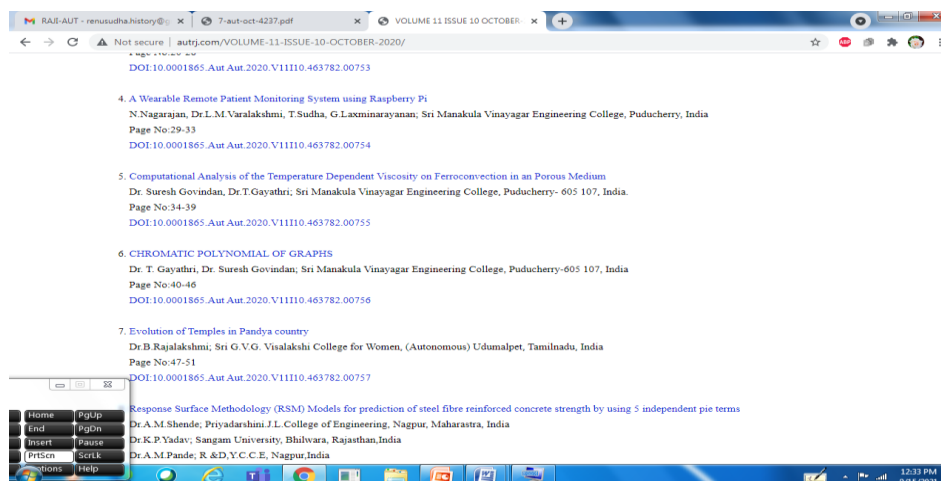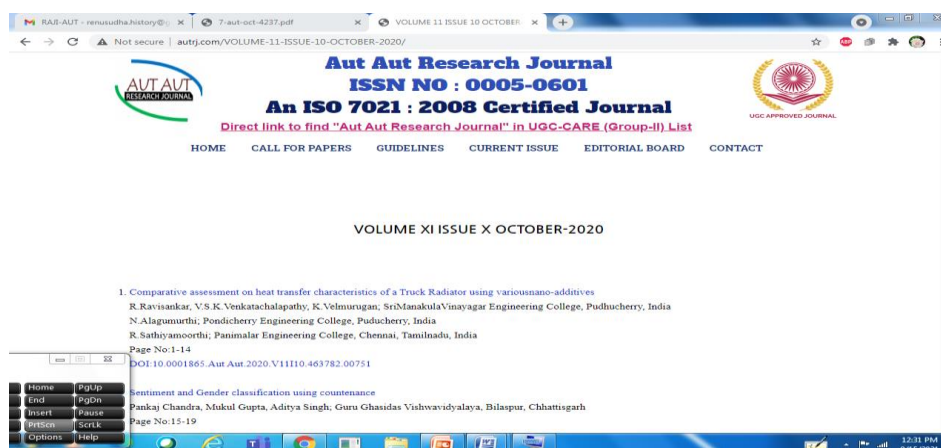
Evolution of Temples in Pandya country

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Abstract

Pandyas were important patrons of temples throughout their rule in Tamil country. Although the temples came into existence from ancient time, the construction of cave temples begun to increase from 6th century C.E., and the structural temples begun to increase from 8th century C.E.Primitive type of Temples in the beginning was called as hypaetheral temples. They were elevated sites without surrounding walls and roofs. Many primitive beliefs like ancestral worship , animism and to temism were followed. But the post Sangam period and later period witnessed the infusion of many religious cultures into Tamil country and the emergence of structural temples. The early Pandya period witnessed an important landmark in the construction of Temples. Temple construction turned into full-stone religious edifice during 7th century C.E, i.e., cave temples.The temple construction was moved towards large and big temples in Tamil country. It is another development of Temple structure in the later period. This paper will shoe light on evolution of Temples in Pandya Period.

Keywords :- Pandyas, Sangam period

Introduction

Generally, India is a land of large number of temples particularly Tamil country is not an exceptional one. Temples are abundant in the Pandya country. They are hypaetheral, big, small and spreaded all over the Pandya country. If we look at the historical context, it is clear that the processes of social relations were forced for changes and were reinforced by various ideas of sects and cults.

Pandyas were important patrons of temples throughout their rule in Tamil country. Although the temples came into existence from ancient time, the construction of cave temples begun to increase from 6th century C.E., and the structural temples begun to increase from 8th century C.E.

Primitive type of Temples in the beginning was called as hypaetheral temples. They were elevated sites without surrounding walls and roofs. Many primitive beliefs like ancestral worship , animism and totemism were followed. But the post Sangam period and later period witnessed the infusion of many religious cultures into Tamil country and the emergence of structural temples.

Sangam Period

Kottam, Koil and Nagaram denote temples in Sangam period. Sangam Anthology which comprises Ettuthogai and Pathupattu provide the informations for the existence and establishment of temples. Further they bring out the functions and activities of the society. In Sangam period people worshiped and performed ritual practices in temples. Many primitive beliefs and magico religious rituals were practiced in natural way of worship. Birds, animals and reptile like snake were used as symbols and vehicles of Gods in later structural temples. Tree was worshipped and attached importance to it as an abode of God or spirit. Perhaps this is the prototype of Totemism. Ancestral worship, Animism and Totemism were popular cult practices on those days.

These kinds of beliefs were rooted in common folk, the refined Brahmanical practices and their edifices are also focused by Sangam texts. Pattinapalai states that Kantu , the embodiment of deity was enshrined at Poduvil Mandram and worshipped by the people. This shrine or cult spot for worship called Poduvil, mandram and referred to in Sangam classics may be generally categorized under the hypaetheral temples.

Ancestoral worship was practiced along with the forms of beliefs like Animism and Totemism. The monuments of funerary or sepulcher character essentially indicate that ancestoral worship was widely followed throughout Tamil Country, particularly under Pandya region. Nadukal or hero stone which was erected in memory of heroes was popular and also worshiped. The scholars identify that in Tamil culture this may be cited as evidence for the origin of temple formation.

In Sangam period Kottam, Koil and Nagaram indicate the shrine places which acquired a worship of particular deity in relation to Tinai or eco-zone system of Kurunji, Mullai, Marutham, Neithal and Palai. According to this each eco-zone had separate Gods and Goddesses. Among them mayon, seyon, varunan and Indran acquired importance in worshipping. All these facts establish that many kinds of Gods and Goddesses existed and many kinds of worship forms were followed. Sangam Anthology which includes Pattupattu and Ettuthogai provides ample evidences to establish these facts. Further many kinds of kuthus like Kuravai Kuthu, Veriyattu and other sacrificial practices characterize the worship pattern, practiced in these shrine spots. However, there is no debris of evidences of these types of temples of Sangam period. But there are a few good pen pictures in the Sangam Anthology about the nature and form of the contemporary religious edifices.

Many alien religious cultures like Aryanism, Buddhism and Jainism were infused into Tamil country during the Sangam and Post Sangam period. The Sangam anthology like Ettuthogai, Pathupattu, Paripadal and Thirumurugarrupadai give the idea of temples as the focus of devotional cult which

was developed later. It is different from Sangam practices, which has the character of Sangam poetry humanism. Humanism refers to reflection of humanistic characteristic nature rather than devotional character of the later period. Thirumurugarrupadai, which describes the particular shrine abode of Kurunji Tinai deity Lord Muruga , gives the understanding of permanent shrine abode for God.

Early Pandya Period

The early Pandya period witnessed an important landmark in the construction of temples. . Temple construction gained more importance under the Pandya and Pallava period. Alwars and Nayanmars were popularised the temple cult at that time. They were responsible for the erection of numerous temples in Tamil Country. At the meantime the Bhakti movement focuses to gain new momentum with temple in their period.

Cave Temples of Pandyas

Temple construction turned into full-stone religious edifice during 7th century C.E, i.e., cave temples. Pallavas were pioneer of cave sturcture. Mahendravarman I who attempted the cave temple at Mandagapattu and he involved vigorously in carving many more temples. Posterior to this development Pandyas attempted many cave temples in their regime from 7th century C.E. The cave temple at Malayadikuruchi appears to be the earliest piece of construction. Further many more cave temples were dotted in the Pandya Kingdom. They are located at Pillayarpatti, Kunnakudi, Anaimalai , Tirupparankundram, Arittappati, Sittannavasal and other places. These cave temples belong to Saiva and Vasihnava sects. Among them large number of cave temples are affiliated to Saivism. The Vishnu cave temples are to be seen in Anaimalai, Thirumayyam and Thiruthangal. Even the early Pandya rulers contributed to the development of cave temples which showed the further development in temple construction. Sittannavasal and Umaiyandar Koil at Thenparankundram are good examples for Jain cave temples. Further inscriptions engraved in these cave temples or sacred cult spots, show the different transition and deviation from the previous period.

Totally sixty cave temples were constructed by Pandya rulers. The significant fact of cave temples of Pandyas is that, they still exist under worship by the people. Cave temples at Tirupparankundram, Tirumayyam, Anaimalai, Kudumiyanmalai, Kunnattur, Arittapatti are cited as examples. Among the cave temples of Pandyas, few of them had developed into famous centres of worship and converted into structural form of temples like Tiruchendur, Kunnattur, Puvalaikudi and Tirukokarnam temples and others. Kalugumalai temple is the monolithic temple in the Pandya kingdom. These cave and

monolith temples were royal executions of Pandyas and they were also patronized by the other people as well as kings.

The another remarkable development seen was a major shift from rock cut style to structural style in the evolution of temples in Tamil country. The developments of structural temples were resulted in the establishment of Brahmadeya, Devadana and Sabha. Large number of temples had been constructed and renovated by Alwars and Nayanmars during the Bhakti Movement. Many inscriptions could be cited as examples to attest this view. Brick structure, stone structure were restored from brick structure into stone structure seemed to be common in the process of temple development from the medieval period. According to the inscriptions found in Manikanteswara temple at Kilamathur, Madurai District, it is understood that the affairs of stone temple are named Srikantheswaram. It was the old Devadana lands which were checked by the time of Vira Pandya. Apart from these it indicates the temples have a brick structure and it was converted into stones.

Structural Temples in Imperial Pandya Period

The temple construction was moved towards large and big temples in Tamil country. It is another development of Temple structure in the later period. Pallavas, Cholas and Pandya rulers were involved in constructing large and big size temples with magnanimous art and architectural features like Kailasanatha temple at Kanchi stands for Pallavas, Bragadeeswara temple at Thanjavur stands for Cholas and Meenakshi temple at Madurai stands for Pandyas .

The later Pandya period evidenced the construction of huge structural temples. Pallavas were the pioneers in this kind of structural development of temples and their magnum opus are Kanchi and Mahabalipuram. Subsequently this pattern was followed and contributed to the construction by Pandyas and Cholas. They were fulfilling reconstruction and renovation of large number of temples in their regime. Later on several huge temples had emerged with large complexes, gopuras and vimanas. Most of the structural temples were constructed with garpagrahas for housing the Gods and Goddesses. Apart from these mandapas were evolved with elaborate rituals. The archaeological, epigraphical and literary evidences provide ample scope to trace the origin and development of various types of temples from early period to 12th century C.E.

Conclusion

At the outset all these facts give the idea of varied types of temples, developed and patronized by Pandya kings in their country. Various types of temples may be catagorized as Sangam age temples (built by perishable materials), Cave temples ,Structural temples ,Temples with large mandapas and

gopuras. These focus categories and explain about the origin and development of temples in Pandya country from Sangam period to later Pandya period.

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RESEARCH ARTICLE

FUNCTIONING OF PUBLIC DISTRIBUTION SYSTEM IN COVID 19 PERIOD

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Manuscript Info	*Abstract*
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	Public Distribution system functioning is an important for ensuring food security especially for the weaker section. PDS has succeeded in securing minimum food requirement but in large size families it food requirement is insufficient. In the pandemic situation small, marginal size family is very difficult to livelihood due to loss of earning. For the welfare of the people the central Government and Statement government has announced several measures to deal with the food in - security situation. For protecting the requirement of food the Central and State government announced to distribute food items to all ration card holder at free of cost, in addition Rs. 1000 , Rs. 500 kits and mosk are provided to imbalanced situation of covid 19 period. In this situation ration shop functioning well. Hence this paper mainly focuses on functioning of ration shop in the pandemic situation.

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Introduction:-

Food, cloth and shelter are an essential for every human being. One of the major problems of basic need is food security to all type of people. Due to increase population rate is the major challenging in India. High degree of income inequality, widespread of poverty, unemployment and malnutrition are the common problem in India. The government of India under Ministry of Consumer Affairs, food and public Distribution to distributed food items to India's poor. Essential commodities like rice wheat kerosene oil, cereal sugar etc are supplied through PDS at affordable price. People are directly purchased from ration shop and full fill the basic need at minimum level. The COVID-19 pandemic is the turning point in modern history it outbreak of COVID 19 has brought about drastic changes in our lives, and by every measure we are going through a great crisis and many experts argue that the world we are entering will be fundamentally different from the one we knew before.

Due to lock down of covid 19 small, medium and large enterprises are not functioning property. After some relaxation announced by the government of India these enterprises are functioning with minimum number of employees other are ideal no earning of income. In this situation the central government and statement government initiated to distributed food items to ration card holders at free of cost.

Review of Literature:-

Pallavi Pathak et.al.(2020) in their study entitled on "Effect of COVID-19 on public distribution system in India" The article express as the economic crisis in covid 19 period the author explain the India's food safety and measures for COVID 19 and its food security and governance challenges further Tamil nadu government issued order to full fill the food insecurity. The study concluded that, Food security exists when all people, at all time, have physical

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and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life.

Thomas &Shanmugam (2018) in their study entitled on "An analysis of the consumer satisfaction with the public distribution system in kottayam district", with the objectives of to study the socioeconomic factors that influence PDS card holders to purchase from the PDS shops, to understand the factors related to customer's satisfaction from the Public Distribution System. The researcher collected primary data from the district by using purposive random sampling technique. They concentrated of BPL SC, BPL ST, and APL categories. To analyze the data the researcher using simple percentages and Liker scale technique. The utilization of services given by the PDS scheme depends upon the satisfaction level of the customers in relation to the quality of services from ration shops. From the above analysis, it could be comprehended that the prevailing PDS system protects the needs and satisfaction level of the customers to some extent, but it has to be implemented and scrutinized at its full swing to realize its basic purposes effusively.

Rukshana Begum&.Archana (2018) the study has been attempt to "A Study on customer perceptions towards Technological Developments in Public Distribution Services [smart card] with Reference to Coimbatore". The objective of the study is to study the socio demographic profile of the respondents, to find the factors influencing the customers' preference towards smart card, to study about the customer satisfaction towards Smart card in public distribution. The primary data were collected from Coimbatore city by adopted convenient random sampling method. The collected data were presented in statistical analysis like simple percentage; Correlation and Chi-Square test were used. The study concluded that the smart card system is more secure and transparent than the ration card system. Using this smart card system we can have Better management of the ration distribution system. The government can have indirect check on the availability of the ration to the beneficiary. It is transparent and has control over prices of some commodities in the open market. Dealer will not be able to keep fake ration cards with them. System helps to modernize traditional rationing and combat corruption up to a great extent.

Bhagyasree PG (2017) in her study entitled on "A Study on the Performance of Public Distribution System With Reference to Colachel Municipality" with the objective of to study the socio-economic conditions of rural population brought under PDS, to evaluate the issues related to access, utilization and perception of PDS among APL and BPL beneficiaries and to study the benefits derived out of PDS. The present study on Public Distribution System has been carried out in Colachel -Municipality of Kalkulam Taluk in Kanyakumari district. The primary data is collected from the sample surveys of the family card holders by using questionnaires, the primary data collected from 64 ration card holders in the study area. Rationing was introduced in India as a food control during the Second World War but has come to stay as a permanent feature of our economy as clearly stated in this study. Today the PDS is intended not only to ensure adequate and timely availability of essential commodities to people in the rural and urban areas, particularly the weaker section. The current study aims to analyze the socio economic background of rural population brought under study area, their perception and utilization level towards PDS commodities.

Statement of problem:
Pandemic of COVID 19 our prime ministry and chief ministry has announced a nationwide lock down for safeguard the people since 25th march 2020 is the initially lock down for 21 days then extended to another 19 days up to 3 may 2020 and again extended for 14 days until 17 may2020, further till 31 may 2020 with some relaxation to slow down. The Tamil nadu government has announced lock down in 6 stages from March 2020 to August 2020. In this period people feel food insecurity and loss of earning income, especially small and marginal groups suffer daily wages it is difficult to maintain their live hood. Public Distribution System is the major key role in this pandemic situation. For the welfare of the people the central Government and Statement government has announced several measures to deal with the food insecurity situation. Food items such as rice, tur dal, oil, sugar and wheat are provided to ration card holder at free of cost in addition with Rs. 1000 was given to every ration card holders for one month by adopted token system for avoid overcrowding at ration shop. In the pandemic situation ration shop is well functioning to full fill the government decision. At this juncture the research undertakes the study of functioning of ration shop in COVID 19 pandemic situation.

Objective of the study:-
To identify the sources of awareness on government announcement

To study the level of satisfaction on quantity of rice in lock down period

To analyze the level of satisfaction on quality of food items.

Methodology:-
The validity of any research depends upon accurate and adequate data. Hence due care was taken for collecting the required data for the study

Sampling Design:
The present study used both primary as well as secondary data. For collecting primary data field survey technique was undertaken in the study area. Field survey technique was conducted in person and the data were collected as per the requirement. The first hand information collected from 75 respondents residing in pallipalayam town and secondary data were collected from various journals and magazines and ration shop.

Frame work of analysis:
For the purpose of analysis, master table was prepared with the information collected through interview schedule. The collected data were presented in the simple table and these tables systematically analyzed with the help of simple percentage, Chi-Square, and scaling technique.

Table No.1:- Demographic factors.

Age group	No. Of Respondents	percentage
20-35	27	36
35-50	39	52
50-65	09	12
Sex		
Male	62	83
Female	13	17
Family size		
1-3	26	35
3-5	38	51
5-7	11	14
Educational qualification		
Illiterate	17	23
School level	30	40
College level	28	37
Status of the respondents		
Government employees	16	21
Private employees	51	68
Business men	02	3
Agriculturalists	03	4
housewife	03	4
Annual Income(Rs)		
100000-300000	47	63
300000-500000	24	32
500000-800000	04	5

Source: Primary data

From the above table 52 percent of the respondents come under 35-50 years of age group, 36 percent of the respondents come under 20-35 years and 12 percent of the respondents age group between 50-65 years. 87 per cent of the respondents were male and 17 per cent of the respondents were female. 51 per cent of the respondents were 3-5members in a family 35 per cent of the respondents were between 1-3 members in a family and 14 per cent of the respondents were 5-7 members in a family. 40 per cent of the respondents were educated at school level, 37 per cent of the respondents were educated at college level and 23 per cent of the respondents were illiterate.68 per cent of the respondents were private employees, 21 per cent of the respondents were government employees, 3 per cent of the respondents were doing business and 4 per cent of the respondents were agriculturalist and house wife. 63 percent of the respondents were earned annual income between Rs.100000-300000, 32 per cent of the respondents were earned Rs. 300000-500000 p.a. and 5 per cent of the respondents were earned annual income between Rs. 500000-800000.

Table No 2:- Display of proposed rice allotment.

Display of New entitlement	No. of respondents	percentage
Displayed	75	100

Source: Primary data.

From the above table 100 percent of the respondents were states that display of new entitlement rice allotment notices are pasted in front of ration shop.

Table No.3:- Source of Information.

Source of information	No. of Respondents	Percentage
T.V News	38	51
newspaper	27	36
neighbor	07	9
Notice Display in ration shop	03	4
Total	**75**	**100**

Sources: Primary data

From the above table 51 per cent of the respondents got awareness about the government announcement of distribution of rice during lock down period through T.V news, 36 per cent of the respondents got information through newspaper,9 percent of the respondents got information from neighbor and 4 percent of the respondents got information through notice pasted at ration shop

Table No. 4:- Delivery of token, allotted time, distribution time and social distance.

Delivery of token	No. of Respondents	Percentage
Delivery at Home	71	95
From ration shop	04	05
Time allotted		
Satisfied	68	91
Not satisfied	07	09
Timely distributed		
Yes	75	100
No	00	00
Social distance		
Maintained	75	100
Not maintained	00	00

Source: primary data

95 per cent of the respondents state that token was distributed at home and meager 5 percent of the respondents received token from ration shop. 91 per cent of the respondents feel that the allotted time by ration shop for distributed food items is satisfied, whereas, 9 per cent of the respondents feel that there is no satisfied for allotted time by ration shop for distributed food items. 100 percent of the respondents were state that the food items are distributed as time mentioned on token and 100 per cent of the respondents are satisfied the maintenance of social distance followed the COVID guidlines at the time of distribution of food items.

Table No.5:- Quantity of items purchase (AT LOCK DOWN PERIOD).

Rice quantity(kgs)(free of cost at lock down period)	No.of Respondents	Percentage
12-32	26	35
32-52	38	51
52-72	11	14
Wheat		
1 kG	13	17
2kgs	62	83
Tur dal		

1kg	75	100
Sugar		
½ kg – $1_{1/2}$ kgs	26	35
$1_{1/2}$ kgs-$2_{1/2}$ kgs	38	51
$2_{1/2}$ kgs-$3_{1/2}$kgs	11	14
Oil		
One kg	75	100

Source: Primary data.

Table No. 5 indicated that 51 per cent of the respondents received rice between 32-52kgs, 35 per cent of the respondents received rice between 12-32 kgs.14 per cent of the respondents received rice between 52-72 kgs. 83 percent of the respondents received wheat at 2kgs, 17 per cent of the respondents received wheat at 1 kg. Cent per cen of the respondents received tur dal. 51 per cent of the respondents received sugar between$1_{1/2}$ kgs -$2_{1/2}$ kgs, 35 per cent of the respondents received sugar between $1/_2$kg -$1_{1/2}$ kgs and 14 percent of the respondents received sugar between $2_{1/2}$kgs – $3_{1/2}$kgs. Cent per cent of the respondents received oil of 1 kg.

Table No. 6:- Level of satisfaction on quantity of rice (Lock down period).

LOS/Quantity	12-32Kgs	32-52Kgs	52-72Kgs
Highly Satisfied	29	28	13
Satisfied	16	15	15
Neutral	6	4	5
Dissatisfied	12	14	22
Highly dissatisfied	12	14	20
Total	**75**	**75**	**75**

Source: Primary data.

The above table shows that the level of satisfaction on quantity of rice, 29 respondents states that highly satisfied under 22-32kgs of rice, 16 respondents were satisfied, 6 respondents does not give any opinion regarding quantity of rice,12 respondents were dissatisfied and highly dissatisfied respectively. 28 respondents state that highly satisfied under 32-42 kgs of rice, 15 respondents were satisfied, 04 respondents were neutral, 14 respondents were dissatisfied and highly dissatisfied respectively. 22 respondents states that dissatisfied under 52-72 kgs of rice, 20 respondents were highly dissatisfied, 15 respondents were satisfied, 13 respondents were highly satisfied and 5 respondents does not give any opinion under 52-72 kgs of rice.

Table No.7:- Level of satisfaction on quality of food items.

Food items	Highly satisfied	satisfied	neutral	dissatisfied	Highly dissatisfied	Total score	Rank
Rice	50*5	15*4	7*3	02*2	01*1	336	I
Tur dal	19*5	23*4	08*3	12*2	13*1	248	III
Wheat	04*5	06*4	03*3	29*2	33*1	144	V
Sugar	29*5	33*4	06*3	04*2	03*1	306	II
Oil	09*5	10*4	16*3	19*2	21*1	192	IV

Source: Primary data.

The above table identify that the level of satisfaction on quality of food items, quality of rice was ranked fist with score value of 336. Sugar was ranked second with score value of 306. Tur dal was in third position with score value of 248.oil was fourth position with score value of 192and wheat was ranked fifth position with score value of 144.

Testing of hyphosis:
Table No. 8:- Size of family and quantity (12-32Kgs) of rice.

factor	Chi- square value	Table Value	d.f	Remark
Family size	32.65	16.422	8	Significant @1%

It is identified from the above table that the calculated chi-square value is greater than the table value and the result is significant at 1% level. Hence, the hypothesis H_o is rejected and the alternative hypothesis H_1 is accepted. From the analysis, it is concluded that there is a close association between the family size and 12-32 Kgs of rice provided.

Table No.9:- Size of family and quantity (32-52Kgs) of rice.

factor	Chi- square value	Table Value	d.f	Remark
Family size	37.25	16.422	8	Significant @1%

It is identified from the above table that the calculated chi-square value is greater than the table value and the result is significant at 1% level. Hence, the hypothesis H_o is rejected and the alternative hypothesis H_1 is accepted. From the analysis, it is concluded that there is a close association between the family size and 32-52 Kgs of rice provided.

Table No.10:- Size of family and quantity (52-72kgs) of rice.

factor	Chi- square value	Table Value	d.f	Remark
Family size	15.86	16.422	8	Significant @1%

It is identified from the above table that the calculated chi-square value is lesser   than the table value and the result is significant at 1% level. Hence, the hypothesis H_o is accepted and the alternative hypothesis H_1 is rejected. From the analysis, it is concluded that there is no close association between the family size and 52-72 Kgs of rice provided.

Findings of the study:
Fifty two percent of the respondents were 35-50 age of age group.

Majority 83 percent of the respondents were male.

Fifty one percent of the respondents family size between 1-3members.

According to education qualification 40per cent of the respondents were educated at school level.

Sixty three percent of the respondents were earning their income between Rs.100000-300000 p.a.

100 percent of the respondents states that display of new entitlement rice allotment notice is pasted in front of ration shop.

Awareness about free distribution of food items, 51 per cent of the respondents got awareness through T.V news.

For distribution of token, 95 percent of the respondents states that token was distributed at home.

91 per cent of the respondents feel that the allotted time by ration shop for distributed food items is satisfied.
100 percent of the respondents state that the food items are distributed as time allotted in token
100 percent of the respondents are satisfied the maintenance of social distance at ration shop.
51 percent of the respondents received quantity of rice between 32-52kgs
83 percent of the respondents received wheat at 2kgs only
Cent percentage of the respondents received tur dal.
51 percent of the respondents received sugar between $1_{1/2}$ kgs -$2_{1/2}$ kgs.
Cent percentage of the respondents received oil of 1 kg.
29 respondents state that highly satisfied under 22-32kgs of rice provided.
28 respondents state that highly satisfied under 32-42 kgs of rice provided
22 respondents state that dissatisfied under 52-72 kgs of rice provided

Identify the level of satisfaction of quality of food items rice was ranked fist with score value of 336.

From the analysis of chi-square test, it is concluded that there is a close association between the family size and 12-32 Kgs of rice provided.

From the analysis of chi-square test, it is concluded that there is a close association between the family size and 32-52 Kgs of rice provided.

From the analysis of chi-square test, it is concluded that there is no close association between the family size and 52-72 Kgs of rice provided.

Recommendation of the Respondents:-
To handle this pandemic situation the government of India atleast one year help to poor to overcome the economic crisis.

Respondents recommended to the government to provide the monetary benefits in this period.

Respondents state that Home usage cylinder distributed through ration shop.

Respondents recommended to the government to Sanction ponni rice through ration shop.

Respondents recommended that increase of wheat quantity to card holders.

Conclusion:-:
The public distribution system was introduced to providing food security to the people with provide good quality and essential commodities to the people at affordable price rate in covid 19 pandemic situation PDS functioning in effective way to food insecurity. In this study area, respondents were fully satisfied with the functioning of ration shop. Quality and quality are satisfied, timely distribution of food items also very satisfied.

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INVESTORS OPINION AND LEVEL OF SATISFACTION TOWARDS POST OFFICE SAVING SCHEMES

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Abstract :   Savings is a important role to all human being. Saving for the future is an important one. Saving is ensure that you have a safe and secure in future but if the saving practices is differ from one another. In India number of investment avenue available to meet different needs of investors. Post office saving schemes is one of the best saving avenue to all type of income earners. The government has made several saving schemes through post office. Due to lack of advertisement the investors are not well aware about post office saving scheme. In this juncture, the research paper made an attempt to study the investors' opinion of post office saving scheme with the objectives of to identify the amount of investment in various post office scheme, to study the investor opinion regarding motivational factors and to analyze the level of satisfaction of investors. The study mainly analyzes the correlation between Annual income and amount of investment. Post office investment scheme is secure financial future at minimum risk.

IndexTerms - **amount of investment, motivational factors and level of satisfaction**

I. INTRODUCTION

Saving is an important factor for economic growth and development. According to classical economists like Adam Smith David Ricardo and J.S. Mill saving is an important determinant of Individual earned income is one part of the economic growth. In beginning of 18th century developed countries people earning income is satisfied as compared to developing countries. In due course developed countries people are decided to saving their money but developing country like India, people are priority to their live consumption. Employment opportunities also low in developing countries after industrialization reduced unemployment problem and earned sufficient amount for their work. People desired to save money after spending necessary expenditure but banks are established in big towns and cities only a common man who want to save money does not ready to spent expenditure for the journey to go to the bank. In order to increase saving habit the government of India established postal network services in absence of banking services in rural area. The post office service is more convenient for small and medium income group. Postal system was introduced by British India. Indian postal system offers varieties of saving schemes to attract investor and enhanced saving pattern.

Review of Literature

Senthil kumar and Deessti Kannaish((2014) the researcher has attempt to study about investors attitude towards savings in post office. The study discussed in different type of invests and rate of interest on various post office account. The study find out that majority of the investors opinion of savings agree that savings are imperative house hold investment help for economic development of the country. Finally concluded that post offices perform their work efficiently and effectively with reference to rural investment. Hence postal investments and rural savings have a dual role to play. Primarily undertake responsibilities of saving of Indian postal investors and secondly help to nation to generate the necessary funds resulting in the society's getting overall benefits.

Sasikala and selvaraj(2017) in their entitles on " A study on the postal saving scheme with special reference to sub-post office, Meensurutty. The researcher identified various services offered by the post office and perception about saving scheme from the analysis, risk bearing capacity and range of investment is the impact of perception among investors. Age of experience and tax payment has been associated with saving motives and behavior of individual.

Anand (2019) the study entitles on rural investors: a study on perception towards postal investment with the objective of to measure level of awareness of rural investor, opinion and attitude of rural investors. Primary data collected from 80 respondents in the study area by using convenient random sampling method. The collected data analyzed with simple statistical tools like percentage and rank correlation. The study concluded that post office served as a financial institution for millions of people in the rural areas. India post offices perform their work efficiently and effectively with reference to rural investment.

Shanmugapriya and Saravanan (2020) in their studied entitles to rural investor's behavior and satisfaction level of financial saving schemes towards post office. The primary objectives of investor's level of satisfaction towards post office financial services. The study focused on the rural investor's behavior with various investment avenues available in the post bank. The study identify that investors were overall satisfied with the post office financial saving schemes like post office saving deposit, post office recurring deposit and post office monthly income scheme. The study concluded that various activities introduced and encourage the people to invest their money to fulfilling their future needs.

Statement of the Problem

In developing countries saving habit are low most of the people spent their income for necessary expenditure only a few of the investors are ready to invest their money. In due course number of investment opportunities available in a country but due to lack of advertisement, the investor does not aware about various investment schemes. Most of the investors preferred post office saving scheme rather than bank. Hence the researcher has undertaken the study on investors' opinion and level of satisfaction towards post office saving schemes.

Objectives of the study

To identify the amount of investment in various post office saving scheme.

To study the investor opinion regarding motivational factors.

To analyze the level of satisfaction of investors.

To identify the problem faced by the investors.

Methodology

The validity of any research depends upon accurate and adequate data. Hence, due care was taken for collecting the required data for the study.

Sampling Design

The present study used both primary as well as secondary data. For collecting primary data, Field survey technique was undertaken in the study area.   Field survey technique was conducted in person and the data were collected as per the requirement. The first hand information collected from 150 respondents residing in pallipalayam town and secondary data were collected from various journals and magazines.

Frame work of analysis

For the purpose of analysis, master table was prepared with the information collected through interview schedule. The collected data were presented in the simple table and these tables were systematically analyzed with the help of simple percentage, Correlation and Henry Garret Ranking technique   .

Table No. 1
Demographic profile of the respondents

Demographic factors	No. of Respondents	Percentage
Age		
35-45	47	31
45-55	39	26
55 & above	64	43
Sex		
Male	102	68
female	48	32
Marital status		
Married	128	85
Unmarried	22	15
Educational Qualification		
Illiterate	12	08
School level	79	53
College level	59	39
Occupational status		
Agriculturalist	16	11
Business men	24	16
Pvt employee	28	19
Govt. employee	70	46
Retired person	12	08
Annual Income		
100000-300000	29	17
300000-500000	67	25
500000 -700000	39	37
700000-900000	15	21
Size of the family		
1-3	28	19

3-5	81	54
5 & above	41	27

Source: Primary data

From the above table, 43 percent of the respondents under the age group of 55 and above.31 percent of the respondents age group between 35-45 and 26per cent of the respondents come under 45-55 years of age group. 68 percent of the respondents were male investors and 32 percent of the respondents were female. 85 percent of the respondents were married and 15 percent of the respondents were unmarried.53 percent of the respondents were educated up to school level, 39 percent of the respondents are college level education and 08 percent of the respondents were illiterate. 46 percent of the respondents were government employees, 19 percent of the respondents were private employees, 16 percent of the respondents were doing business and 08 percent of the respondents were comes under retirement category.. 37 percent of the respondents were earning annual income between Rs. 500000 to 700000, 25 per cent of the respondents were earning annul income between Rs.300000to 500000,21 per cent of the respondents were earning Rs.700000-900000 and 17 percent of the respondents were earning income between Rs.100000-300000. 54 percent of the respondent's family size between 3-5 members, 27 percent of the respondent's family size is above 5 members and 19 percent of the respondent's family size between 1-3 members in the study area.

Table No.2

Sources of awareness

Sources	No. of Respondents	Percentage
Advertisement	36	24
Agent	83	55
Friends and relatives	31	21
Total	150	100

Source: Primary data

From the above table 55 percent of the respondents aware about various type of investment through agent, 24 per cent of the respondents aware about investment through advertisement and 21 percent of the respondents aware through friends and relatives.

Table 3

Amount of investment

Amount (pm)(Rs.)	No. of Respondents	Percentage
Up to 1000	24	16
1000-2000	52	35
2000-3000	38	25
3000 -4000	36	24
Total	150	100

Source: Primary data

Table No 3 clearly shows that 35 percent of the respondents invest the amount between Rs.1000 to 2000 per month. 25 per cent of the respondents invest Rs.2000-3000 per month. 24percent of the respondents invest monthly income between Rs.3000 to 4000 whereas, 16 percent of the respondents invest their money up to Rs.1000 per month..

Table No. 4

Behavior of investment

Investment behavior,	No. of Respondents	Percentage
Regular	128	85
occasionally	22	15
Total	150	100

Source: Primary data

85 per cent of the respondents said that their behavior of investment in regular basic and 15 percent of the respondents said that occasionally invest their money.

Table No.5
Type of Investment

Investment type	No. of Respondents
Post Office Saving Deposit	50
Post office Time Deposit	20
Post office Recurring Deposit	150
Post office Monthly Income Scheme	50
KVP	10
NSC	80
Deposit for senior citizen	20
Public Provident fund	10

Source: primary data

    Among the different type of investment 150 respondents were invested in post office recurring deposit scheme, 80 respondents preferred NSC, 50 respondents preferred saving and MIS respectively,20 respondents are preferred time deposit and deposit for senior citizen and 10 respondents preferred Public Provident Fund.

Table No.6
Motivational factors to invest

Motivational factors	No. of Respondents	Percentage
To meet emergency need	10	7
To meet family needs in future	12	8
Children education purpose	20	14
Regular income	25	17
Reduce tax burden	34	23
Getting security during old age	49	33
Total	150	100

Source: primary data

    The above table clearly shows that 33 percent of the respondents invest their income for getting security during old age,23 percent of the respondents enjoy reduction of tax burden,17 percent of the respondents states that the regular income is the motivational factor for invest the money,14 percent of the respondents feels that to meet the educational expenditure as a motivational factor,8 percent of the respondents to meet family needs in future and 7 percent of the respondents states that meet emergency need is the motivational factor to invest money.

Table No.7
LEVEL OF SATISFACTION

Factors	Highly satisfied	satisfied	neutral	Dis-satisfied	Highly dissatisfied	Total score	Rank
providing latest Information from post office	15*5	33*4	25*3	40*2	37*1	399	V
Agent commission	44*5	49*4	22*3	19*2	16*1	536	I
Government regulation	23*5	45*4	27*3	24*2	31*1	455	III
Period of Maturity	42*5	44*4	18*3	10*2	36*1	496	II
Amount of repayment after maturity period	37*5	26*4	15*3	25*2	47*1	431	IV

        Table No. 7 Clearly shows that the level of satisfaction ,agent commission was ranked first with score value of 536, maturity period was ranked second position with total score value of 496, government regulation was ranked third position with score value of455. Amount of repayment after maturity period was fourth rank with score value of 431 and providing latest information from post office is the fifth position with score value of 399.

Table No.8
Correlation between Annual Income and Amount of Investment

Annual income(Rsin lakhs)	x	Amountof investment(Rs)					f	fu	Fu²	fuv
			1000	1000-2000	2000-3000	3000-4000				
		y	500	1500	2500	3500				
		u/v	-1	0	1	2				
100000-300000	200000	-1	15 15	7 0	5 -5	2 -4	29	-29	29	6
300000-500000	400000	0	6 0	39 0	12 0	10 0	67	0	0	0
500000-700000	600000	1	2 -2	3 0	16 16	18 36	39	39	39	50
70000-900000	800000	2	1 -2	3 0	5 10	6 24	15	30	60	32
total	f	-	24	52	38	36	150	40	128	88
		fu	-24	0	38	72	86			
		Fv²	24	0	38	144	206			
		fuv	11	0	21	56	88			

$$= \frac{N\sum fu-(\sum fu)(\sum fv)}{\sqrt{N\sum fu2-(\sum fu)2(N\sum fv2-(\sum fv)2}}$$

$$= \frac{150*88-(40)(86)}{\sqrt{52}*128-(40)2(150*206-(86)2}}$$

$$=+0.8$$

The above table clearly states that there is a positively correlation between annual income and amount of investment.

Table No 9
Problem faced by the investors

Problems	Total score	Mean score	Rank
Huge formalities	7687	51.25	III
Delay in processing	8446	56.31	I
Lack of agent support	8157	54.38	II
Inadequate information	6625	44.17	IV

Source: primary data

From the above table shows that Delay in processing is the first rank with mean score value 56.31, lack of agent support was second rank with mean score 54.38,huge formalities was ranked third with mean value 51.25, whereas, inadequate information was ranked fourth position with mean value 44.17.

Findings

43 percent of the respondents were come under the age group of 55 and above

68 percent of the respondents were male investors

According to marital status wise 85 per cent of the respondents are married

In educational qualification 53 per cent of the respondents were educated up to school level

Occupational status of the respondents in the study area wise 46 percent of the respondents were government employees

37 per cent of the respondents annual income between Rs. 300000-500000.

54 per cent of the respondents family size between 3-5 members.

On awareness about various post office saving scheme, 55per cent of the respondents aware through agent.

35 percent of the respondents invest monthly income of Rs.1000 to 2000.

85 percent of the respondents invest their money in regular basis.

Most of the respondents were preferred recurring deposit scheme.

Getting security during old age is the important motivational factors.

Agent commission was ranked first with score value 536

Positively correlated between earning annual income and amount of investment.

Delay in processing is the first position with mean score 56.31.

Conclusion

Indian post service is vital role for invest their money and also support to Indian economy through saving of human being. The present study concentrates on investors opinion and satisfaction of postal saving schemes. Higher income group never interest to invest the money. The main objective of sample investors preferred Recurring Deposit Schemes and security during old age is major motivational factors in this study area.post office of our country actively performed to attract more investors as they provide higher rate of interest.

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AWARENESS, ATTITUDE AND PRACTICES TOWARDS PANDEMIC COVID-19 AMONG COLLEGE STUDENTS IN UDUMALPET

❒ **Dr.K. Umamageswari***
R. Beena**

ABSTRACT

Health is dynamic in nature and a sound health paves for sound mind. Corona virus (Covid-19) is an easily transferable infectious disease which spreads when an individual gets in contact with Covid-19 infected person or through its contaminated environment. So, the Government of India announced a complete lockdown all over the country and Ministry of Health department made various awareness programs on Covid-19. In spite of welfare measures taken, awareness, attitude and preventive practices remains most important factors in limiting the massive spread of virus. An online based study regarding awareness, attitude and preventive practices on Covid-19 was conducted among 250 number of college students in Udumalpetand provided that the majority of them were aware of pandemic virus. Moreover, only moderate level of attitude on change of Covid-19 situation prevailed with slight liberal in following the preventive practices. The study concluded that it is advisable to follow the rules and regulations laid by Ministry of Health especially fewer immune people by avoiding close contact with others to evade the current pandemic situation.

Keywords : Covid-19, Pandemic, Awareness, Attitude, Practice

1. INTRODUCTION

Health is a positive status of human being which drives for development of physical and mental capacities "Better physical and mental wellbeing without any kind of infirmity" has been stated to be as "Good Health" by WHO (World Health Organization)

Healthcare industry in an economy is a segment that offers services relating to health and welfare for the people with preventive, healing and rehabilitative care. It consists of various interdisciplinary teams of skilled and para-professionals inorder to cater the health needs of the residents.

1.1 INDIAN HEALTHCARE INDUSTRY

Health is one of the elementary human right in the Indian Constitution. Indian Healthcare delivery institutions are the backbone of the healthcare system. It

is the industry which is facing a rapid growth of about to fifteen percent that is expected to touch by around two hundred and sixty billion in 2020 which is currently with the market size of about sixty billion.

Healthcare sector in India is comprised with hospitals, medical equipment's/devices, insurance, medical tourism and outsourcing. The health programme of the nation (NHP) targets for improvement of the present life expectancy rate 68.35 percent to 70 percent by the end of 2020. Health and welfare department of the nation is stupendous in reduction of maternal mortality rate which is presently at the rate of 2.3 percent where incessantly aims to reduce it to the rate of 2.1percent by 2025.Also,in recent years medical tourism in India has been increased from 0.98million to 1.07million. A robust Indian healthcare system drives the gross domestic

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growth which ways for attracting foreign exchange earnings and the current sector is expected to generate around forty million healthcare employment opportunities in India by the end of 2030. Furthermore, the goals and components of NHM (National Health Mission) also fuels for the tremendous growth of the Indian public healthcare industry.

1.2   NOVEL CORONAVIRUS (COVID-19)

Novel corona virus disease in 2019 (COVID-19) is the most dangerous respiratory disease which created a very big disaster among the human life in the world. It has been considered as one of the fastest spreading viral infection which was first discovered in Wuhan, China in 2019. Later it started in and around Asia and soon expanded rapidly around the globe. Covid-19 easily spreads from one person to another through droplets/breathe and direct contact of the infected person and also from droplets which fall on surfaces and objects where the virus lives for a particular period makes the virus to spread soon when the surface or object is touched. After H1N1 virus in 2009, Ebola and Polio on 2014, Covid-19 was declared as an sixth public health emergency concern in January 30th 2020 by World Health Organisation (WHO) and as an pandemic on March 11, 2020. It has outreached among 210 counties andwithmore than twenty million confirmed cases, thirteen million recovered cases and more than eight lakh deaths until mid of August 2020.

India has reported the first case of Covid-19 in January 2020. The Ministry of Health and Family Welfare stated that it was in Kerala and patient's travel history was from China who is a student of Wuhan University and the first case in India was confirmed by the National Institute of Virology. India has more than 2.46 million virus confirmed cases, 1.75 million recovered cases and 48 thousand deaths until August 2020.Government of India has facilitated the country with 166 government approved laboratories supported by ICMR to test Covid-19 symptomatic individuals at free of cost. Nearly 70 private laboratories were also permitted totestCorona,virus. The Finance Minister announced a relief fund of about 1.7 lakh crore under Pradhan Mantri Garib Kalyan Yojana scheme which covers health insurance of Rs.50lakh for the pandemic treating health workers and offers pulses, rice, wheat, gas cylinders for the poor families every month at free of cost and also credits upto Rs.500 for every women account holders of Pradhan Mantri Garib Kalyan Yojana.

According to the State of TamilNadu, the first case of pandemic Covid-19 was reported on 7th March 2020, a resident in Kancheepuram who has returned India from Oman. TamilNadu has the highest number of Covid-19 positive cases in India after Maharashtra. The capital district Chennai was massively affected by corona virus and later all of the districts in TamilNadu suffered with the pandemic situation. The Health Department mentioned that nearly 88 percent of the patients were asymptomatic and moreover the State saw increased deaths in the mid of June. TamilNadu has 320 thousand Covid-19 confirmed cases, 261 thousand recovered cases and 5392 deaths until August 2020. The state is equipped with eighty-three Covid-19 testing centers and has facilitated 300 medical camps where the state government plans to raise upto 450.TamilNadu Government released a sum of Rs.60 crores a welfare measure to combat Covid-19 and announced cash assistance of Rs.1000 for all the families combined with free supply of food commodities. Like other districts, Tiruppur also got affected of Covid-19 and the outbreak is increasing day by day with total of 1431 cases which has459 active cases, 36 discharges and 5703 house quarantined cases until mid of August 2020.

According to World Health organization (WHO) self-separation, social distancing, hygienic practices like wearing masks and usage of sanitizers at frequent intervals may control the spreading of infection from one to another. Since there is no vaccine or medicine available against Covid-19, Government laid various rules and regulations to limit the community activities for the massive spread of virus in the densely populated country. A common lockdown was followed all over the country for more than two months and residents were advised to stay home on considering the safety of public health. Each and everyone has the responsibility and power to prevent the pandemic corona virus infection so inorder to endow the residents with the information regarding Covid-19, Government of India developed AarogyaSetu

Application for the mobile phone users. It helps to track the Covid-19 positive reported cases nearer through location generated social graph and also instructs people about the self-isolation, hygienic practices, emergency helpline, updates on covid-19 cases, rules and regulations. More than fifteen crore Indians are getting updated on Covid-19 information through this application.

The study has been carried out in Udumalpet taluk of Tiruppur district which has reported its first Covid-19 positive case on 13th April 2020.In the present study, an investigation regarding the awareness, attitude and Covid-19 preventive practices among the college students of Udumalpet taluk was carried out to know about the emerging Covid-19 infection.

1.3 STATEMENT OF THE PROBLEM

Health is an important aspect of nations human resource. Good health care facilities and services are essential for society that contributes for the social development. In this dynamic environment and changing nature of health aspects, the health problems have become a great concern for the contemporary world. Only a Government can plan, implement and achieve its goal towards the welfare of the people beyond the element of profitability. So they design the policies to increase the efficiency of public expenditure and maximize the benefits of every rupee spend for public intentions. Government outlays for quality service delivery mechanism for the achievement of better health outcomes.

Covid-19 is currently the most terrible situation and its issue is spoiling one's day to day activities which further lead to lower the economic standards of the nation. Since there is no prevention vaccine for this rapidly spreading infection our Government laid complete lockdown to reduce the speed and eradicate the Covid-19 infection. This situation induced the researcher to study on awareness, attitude and preventive practices followed by the residents against the battle of Covid-19. So, the study has been carried out among the College students as they play a vital role in creating voluntary awareness to inculcate knowledge regarding Covid-19 among the individuals through social media and other types of

communication channels. And so the researcher made study on awareness, attitude and practices towards pandemic covid-19 among college students in Udumalpet.

1.4 OBECTIVES OF THE STUDY

To identify the socio-demographic profile of the respondents

- To know the level of awareness towards Covid-19among the College students in Udumalpet.

- To identify the attitude on Covid-19among the College students in Udumalpet

- To investigate the preventive practices followed to avoid Covid-19among the College students in Udumalpet.

1.5 METHODOLOGY

Government laid rules, regulations, restrictions and maintained a complete lockdown to minimize the spread of the virus. Since it's a great hurdle to conduct a direct survey, the study was carried out in the month of August among the college students of Udumalpet through an online based survey. A self-structured questionnaire using google forms containing questions regarding Covid-19 awareness, attitude and preventive practices followed was prepared. The questionnaire link was circulated through google mail and whatsapp application among mobile phone users from 250 respondents by adopting convenience sampling method. Each of the respondents were given details about the purpose of the study and willingness to respond was ensured.The collected primary data has been consolidated into master table and analysed by using statistical tools like percentage analysis, likert scaling technique, chi-square test, weighted average method and garrett ranking method.

2. REVIEW OF LITERATURE

- Mohammed K. Al.Hanawi et al., (2020) made a study on "Knowledge, Attitude and Practice Toward COVID-19among the Public in the Kingdom of Saudi Arabia: A Cross-Sectional Study". A cross-sectional online based study was carried out and data was collection among 3388 respondents. It found out that, majority of the respondents were aware of COVID-19 and

indicates that the respondents had optimistic attitude towards pandemic virus. It also analysed that preventive practices towards COVID-19 was good and stated that, men respondents had less knowledge, less optimistic attitude and preventive practices when compared to women. The study concluded that health education and its preventive practices for the particular interior areas can be raised so that pandemic infection could be reduced.

- Bao-Liang Zhong et al., (2020) did a study on "Knowledge, attitude and practices (KAP) towards Covid-19 among Chinese residents during the rapid rise period of the COVID-19 outbreak: a quick online cross-sectional survey". An online based KAP questionnaire was circulated among 6910 respondents and provided that, ninety per cent of the respondents had COVID-19 knowledge and ninety seven per cent of the respondents mentioned that China could win against the COVID-19 battle. It also provided that, ninety eight percent of them wore masks and follow preventive practices like usage of sanitizers and social distancing. The researcher suggested to improve welfare measures for needy.

3. FINDINGS, SUGGESTIONS AND CONCLUSION

- Forty five percent of the respondents were female
- Nearly 56 per cent (55.75%) of the respondents belonged to the age 21
- Majority (90%) of the respondents were undergraduates.
- Majority (95%) of the respondents were unmarried.
- More than half (55%) of the respondents belonged to nuclear family.
- Sixty-five per cent of the respondents had 3-5 members in the family.
- Nearly sixty-six per cent (64.57%) of the respondents had family income between Rs.5001-Rs.25,000
- All of the respondents were aware of Covid-19
- Majority (79%) of the respondents came to know about Covid-19 during the month of February

2020.

- Majority (90%) of the respondents' source to know about Covid-19 was television followed by social media and newspaper.
- Sixty-fiveper cent of the respondents mentioned that government created proper awareness on Covid-19.
- All of the respondents provided that they were aware of Covid-19 symptoms.
- Majority (90%) of the respondents know where to go if they had symptoms of Covid-19.
- 79.06 per cent of the respondents stated that they can get checked through Government hospitals.
- Majority (96%) of the respondents provided that avoiding crowd and staying at home avoids Covid-19.
- All of the respondents stated that Covid-19 ruined the day to day living activities.
- 65.02 per cent of the respondents were aware of Aarogyasetu application.
- Among 163 respondentswho were aware of the application,49.07 per cent of them used it to get Covid-19 updates, 26.8 per cent of them used to get physicians advice on prevention practices, diet and exercises, 24.4 per cent availed the application to get e- pass.
- Nearly seventy per cent (68.7%) of the respondents stated that Covid-19 situation will not come under control.
- Respondents mentioned that social distancing was the major factor to be practiced to avoid Covid-19 which has ranked first followed by wearing masks, gloves and washing hands often.
- More than half (50.4%) of the respondents provided that Government measures were enough to prevent Covid-19 outbreak.
- Among 126 respondents who stated about the sufficiency of Government measure, fifty four percent of them were satisfied with awareness /preventive education on Covid-19 followed by herbal drink and bleaching agent around the surroundings.
- Majority (96%) of the respondents availed welfare

measure provided by the Government during lockdown period.

- Among 240 respondents who have availed Government welfare measures, 92 per cent of them received free ration products and 90 percent of them received an amount of Rs.1000 as Covid-19 relief fund.

3.1 RESULTS

1. Using **chi-square analysis**, relationship between profile of the respondents and the respondent's attitude towards Covid-19 were made.

- There was a significant relationship between age of the respondents with the respondent's attitude towards Covid-19.

Using **chi-square analysis**, relationship between profile of the respondents and the respondent's level of satisfaction Government measures to prevent Covid-19 outbreak.

- There was a significant relationship betweennature of the respondents and the level of satisfaction towards Government measures to prevent Covid-19 outbreak.

2. **Weighted average score** method is adopted to analyse the foremost satisfied factor and calculated by taking into consideration as:

Highly satisfied	Satisfied	Neutral	Dissatisfied	Highly Dissatisfied
2	1	0	-1	-2

Awareness and preventive Education on Covid-19 was the most weighted factor followed by herbal drink and bleaching agent around the surroundings.

3. **Garrett ranking** technique has been used to identify the most vital factor that are to be practiced to prevent Covid-19. For this purpose, a total of 250 respondents were asked to rank them according to their choice and the order of merit given by the respondents was converted into ranks by using the Garrett ranking formula.

Respondents mentioned that social distancing was the major factor to be practiced to avoid Covid-19 has ranked first followed by wearing masks, gloves, washing hands often, avoiding unnecessary travel, regular exercises and healthy immunity boosting diet.

3.2 SUGGESTIONS

- Efforts should be taken to create much more awareness on Covid-19 in the deep interior urban and rural areas.
- Enhancement of preventive practices to avoid Covid-19 can be made.
- It is primary to create increased awareness on regular physical exercise, breath and yoga activities.
- Encouraging every individual for the usage of AarogyaSetu mobile application.

3.3 CONCLUSION

The Pandemic Covid-19 is highly transmittable and there inculcating increased awareness is the primary aspect to restrain the contagious communication of Covid-19 infection. The results showed that respondents had a good level of awareness and moderate level of attitude on the situation of Covid-19. In consideration of worse situation of Covid-19, following preventive practices strictly could reduce the spreading of infection which is slightly liberal among the respondents. Also, it is advisable to follow the rules and regulations laid by Ministry of Health especially fewer immune people by avoiding close contact with others to evade the current pandemic situation.However, several necessary knowledgeable factors like manner of transmission, acute symptoms, hygienic preventive educational programmes regarding Covid-19 to be inculcated with well-structured informative programmes which contribute for preventive practices.

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VIRTUAL LEARNING IN HIGHER EDUCATION IN COVID-19

Dr. C. Brindhadevi, *Assistant Professor, Sri GVG Visalakshi College for Women (Autonomous), Udumalpet*

Abstract: - *The Covid-19 pandemic has enforced many sectors to shift their bases online including education, where numerous colleges have started teaching their students through virtual platforms across the world. In India, however, the story in terms of online education tends to differ as compared to remainder of the world. Before this pandemic period, there was already high growth and adoption of virtual learning within the field of education has been introduced, with global edtech investments reaching US$18.66 billion in 2019 and therefore the overall marketplace for online education projected to succeed in $350 Billion by 2025. It is often of language apps, virtual teaching & coaching, video conferencing tools, or online learning software, there has been a serious surge in usage since Covid-19.*

Keywords: *Virtual platforms, Covid-19, e-learning.*

Introduction: - The Covid-19 pandemic has enforced many sectors to shift their bases online including education, where numerous colleges have started teaching their students through virtual platforms across the world. In India, however, the story in terms of online education tends to differ as compared to remainder of the world.

Countries are at dissimilar opinions in their Coid-19 infection rates, worldwide there are currently quite billion youngsters in many countries suffering from college closures thanks to the pandemic. A sudden change of shift from the classroom in many parts of the world, some are wondering whether the adoption of online learning will still persist post-pandemic, and the way such a change would impact the worldwide education marketplace.

Before this pandemic period, there was already high growth and adoption of virtual learning within the field of education has been introduced, with global edtech investments reaching US$18.66 billion in 2019 and therefore the overall marketplace for online education projected to succeed in $350 Billion by 2025. It is often of language apps, virtual teaching & coaching, video conferencing tools, or online learning software, there has been a serious surge in the usage since Covid-19.

Education Sector During Covid-19 Period – A Summary: UNESCO has projected that about 1.26 billion youngsters or 70 percent of youngsters round the world have had their education disturbed due to the pandemic and an outsized number of those youngsters are from what UNESCO calls the "low tech or no tech" phase, with India contributing 300 million of the 1.26 billion youngsters. Given this backdrop, Professor Sahana Murthy described things behind the surge of online education in India because the clue of "Emergency Remote Teaching". She narrates that, there's a change between emergency remote teaching and effective online learning. She explained that for online teaching, a long side the need of tools like online platforms, one needs access also as trained teachers. She resolved her primary declaration by highlighting on the position of shifting the attitudes of the teachers also as students since online teaching only limits to a through a face-to-face lens. A method during which this might be applied is through the LCM Model, which focusses on a "learner-centric approach towards the designing and conducting of online courses".

Dr. Shakila Shamsu shed light on the practice of technology for education shouldn't be seen as an outcome of the pandemic, but as a thought that has been ongoing for several years. She documented now by outlining the diligence of the National Mission on Education through ICT which was a robust approval of the 11th five-year plan. She illuminated how the Satellite Instructional Television Experiment within the 1970s and academic broadcasting that happen over the radio were ways during which technology was utilized in the sector of education, giving "equitable access" to all or any those learning through those channels. By the initiative of MHRD had launched a channel for college kids to require online courses and at the present 15 million students is enrolled with it. It also thrown a subsidiary direct-to-home channel in 2019, called Swayam Prabha. The numbers of viewers are doubled compared to its parent channel. She believed that the rationale India isn't ready to transition swiftly from face-to-face education to remote learning is that the absence of institutional preparedness and simple understanding by students to the new mode of delivering classes. She submitted that "higher education institutions should start preparing a tutorial plan of action." Therefore, there's a "need to watch institutions, faculty and students to repurpose e-content during a manner that turns into the curricula for attaining the specified learning objectives of that specific course". She established her primary statements by saying that to succeed in a bigger audience, it's essential to organize e-content which should be made obtainable in local languages.

Dr. Ashwin Fernandes from his views about Covid-19 fetched that it's a "second storm to education in India". He said this is often due to three key reasons. Firstly, the enlarged practice of technology for varied ideas, particularly for education, has "encouraged assurance for users". Secondly, India has tried to trace the footpaths of UK, US and UNESCO prototypes of online education and lastly it hang on how both these factors "level the playing field for Indian universities." Discussing the study conducted by his organization which focused on whether India was equipped for a digital transformation, he revealed that quite 80 percent of India's population uses their mobile hotspot for accessing the web. 96 percent of scholars are using android mobile and accessing to educational resources faced problems with internet connectivity.

He says it, might be happening due to the low cost of internet in India, because it steered to the overburdening of systems. From his views he feels that India is currently in beginning stage of the transition from face-to-face learning to online education, where classes have begun to be taken online. Stage 2 of this transition is where there's "100 percent course delivery online (assessment, grading)" and Stage 3 is where there's "thorough transfer in fact credit through online mode." He determined by suggesting that, for India to make an efficient modification to online platforms for education, it must discourse the facility supply issues as soon and then later it brings a change towards online teaching and learning and conduct robust training for faculty and students on ed-tech tools.

Dr. V. Sridhar enlightened the "Nomenclature of Online Education", which incorporates "Learning Management", "Course Delivery", "Assessment and Evaluation" and "Sync Course Conduct." believing Dr. Fernandes on the overcapacity of network connections resulting in the poor connectivity experienced by students in online education, he suggested a couple of possible solutions. The think is that we've to supply internet connectivity through DTH or cable networks or give internet connection through landline infrastructure. Another roadblock to online education, is that the observing of online assessment. so as to extend internet connection in rural areas, connections might be taken from cities or places with an opportunity of upper internet connection and access.

According to a report of the MHRD, Government of India conducted a survey on education sector and observed that there are 993 universities, 39,931 Colleges and 10,725 other (Stand Alone) Institutions scheduled on their gateway, which contribute to education. These institutions further reflect the scholar density of India because the total enrolments in education per annum are nearly 37.4 million, reflecting the expanding horizons of the education industry. The universe was seen grasping bound by the passing day up to Coronavirus impacted the country intensely. While academic experts are pushing for online models of education - be it classroom learning or lessons, we are however to find out how successfully a nation that primarily relies on an offline mode of teaching can seamlessly transgress to a web medium of teaching and education. So, the question is will the Coronavirus Pandemic end in a replacement solution for education and innovation.

The conventional Indian education system follows face-to-face or physical teaching, albeit the trend of audio-visual aids in classrooms was introduced a decade ago. Popular academia's in India like the University of Delhi are offering online classes to its students already. But countless education organizations in India aren't furnished with such amenities. Within the event of such a niche, some students might face the brunt brutally, which could affect their entire school year. Unless we adopt from countries where the quality of education is way more advanced & flexible compared to ours.

Education System Equipped to Handle the Change: - In a study by Times education in 2018, the front-runners of famous worldwide universities were of the opinion that online teaching could never match with physical room teaching. Once we mention how equipped Indian education System to handle the change, we'd like to stay in mind that the digital shift in India is comparatively new. It is not only to our country India, but in Asia also. You'll be amazed to understand that the primary Asian Massive Open Online Course (MOOC) was developed by the Hong Kong University of Science and Technology within the year 2012 only.

Indian Educational institutions will take a period to handle the modification and be welcoming the new methods because the approach of the education system here may be a lecture-based approach to teaching. Digital teaching is more evident in schools and therefore the school students/ teachers/parents are easier with this approach in comparison to education set-up in India. Within the event of COVID-19, online teaching has become a necessity, for not only colleges in India but worldwide to seem for innovative solutions during a short period of your time and to always have a Plan-B in situ.

2020 Year for Higher Educational Sector: -

Examinations: With board exams, university exams, college exams, the doorway test being postponed, it'll be an enormous challenge for colleges to finish their syllabus on time without compromising on the education quality. By the postponement in semester exams to college being shutdown to delay in national level entrance tests, it's the tutorial year of the scholars which will suffer. As already discussed, JEE Main which is that the ticket to engineering education in India has already been postponed thanks to the Coronavirus outbreak & will cause the delay within the start of educational sessions for many of the engineering colleges and most of the opposite colleges will witness a delay also. Not just that it's estimated that students meaning to take admission in 2020 are now clueless on how and where they ought to apply to high schools from here on.

2020 Admission for Colleges Amidst: an outsized chunk of India's admission system is fractured and most of the scholars in India believe the offline process for admissions. it's a known incontrovertible fact that most of the people within the country don't have access to high-speed Wi-Fi and most of the scholars in small cities/towns/ villages prefer the offline admission process. Consistent with a piece of writing published in Times, "schools with more or less open admissions like Arizona State, Western Governors and Southern New Hampshire Universities fundamentally rethought and reconstructed their UG programs, with virtual media to supply increased access at lower cost, the selective colleges generally went on with their classroom business as was common." To implement an equivalent in India could be a time-taking process merely due to a weak education system.

While it's a still gray area, platforms like ours have provisions to facilitate remote applications to high schools in India for his or her UG & PG. College Dekho features a platform called the Common form or CAF, wherein students can refill one form to use to quite 250+ colleges in India at one go! This is often facilitated with a web counseling facility, wherein education experts counsel students on the simplest course, degree or college for college kids basis his/ her academic background and aspiration. Students can use this chance for online applications to high schools for admissions in 2020.

Educational Institutions Placements: The COVID-19 panic period has directed to numerous colleges in India to defer their GD/ PI (Group Discussion/ Personal Interview) process. Popular management colleges like Management Development MDI had scheduled the WAT-GD-PI round in Mumbai from March 21-26, 2020 but an equivalent has been postponed and therefore the revised dates are going to be issued soon. Likewise, another standard college IIM Lucknow has also decided to delay its GD-PI for an indefinite period of your time. There are chances that the 2020 placement season may witness a dip because the World Economy goes through a huge decline. With new and more added companies demanding an 'outplacement', wherein support facility is provided by few organizations to assist previous employee's transition to fresh jobs or are deferring their joining dates, it'll not be aggressive to assume that globally, we are heading towards a serious recession in 2020. The Indian Economy and therefore the market will take time to regrow. Within the event of such uncertainty, students in 2020 can seize this chance to require up a certificate/ pursue an academic degree.

MHRD Digital Initiatives for Education : The best open access resources with some best ICT Initiatives (In India & Abroad) with their access link like National digital Library, SWAYAM online courses, National Knowledge Network, NPTEL, Info part, Talks to teacher, A- View, Virtual Labs, FOSSEE, Spoken Tutorial, e- Yantra, Oscar++, E-Kalpa, NCERT Text Books, directory of open access Journals, Open Knowledge Repository – International Bank for Reconstruction and Development, UG/PG MOOCs, e- PG Pathshala, SWAYAMPRABHA,e-shodh Sindhu, Vidwan, Oxford Open, Cambridge University Press etc… for the advantage of Students and school members within the field of upper Education.

Conclusion: Since our country has been adapting to the new-age learning, but there still lays a difficulty in making the endeavor's entirely successful. Anything still remains together is that merely 45 Crore general public of our overall population of the country have access to the internet and thus to Virtual and e-learning. The people residing in rural areas are still considerably bereft of the newest advancements and thus hampering the

explanation for online learning. Now, virtual classrooms aren't only hooked in to e-lectures but also require one to possess access to the e-content and online study material, practice sheets etc. as well. And that's where we lag behind as India isn't fully equipped to form education reach all corners of the state via digital platforms or online classrooms or Virtual technology. During a country just like the U.S.A, there are many low-income students who don't have access to broad bands and laptops; digital learning won't be the perfect solution. An equivalent is that the case with India, not every student here is tech-savvy or has access to the high-speed internet and can therefore suffer. When classes actually commence online, many students will suffer due to their inability in touch the value. Students who have access and thorough knowledge towards technology are capable of learning new things in online or virtual educational platforms. A report says that on an average, students preserve 25-60% more material when learning online (virtually) compared to only 8-10% during a classroom. This is often mostly thanks to the scholars having the ability to find out faster online; e-learning requires 40-60% less time to find out than during a traditional classroom location since students can learn at their specific pace, accepted back and re-reading, skipping, or accelerating through concepts as they choose.

Unless India makes internet available to all or any, there are chances that the gap in education quality may widen. The scholars who aren't privileged just like the others are going to be held back thanks to the present resort and there's no denying that. But universities and therefore the government of India are relentlessly trying to return up with an answer to resolve this problem.

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Editor

Epiregularity in generalized topological space

A. Kalavathi[1*], R. Angel Joy[2] and R. Selvavadivu[3]

Abstract
The notion of generalized epiregularity in generalized topological space is introduced and investigate some of its properties in this paper.

Keywords
Generalized Epiregular, Generalized Hausdorff, Generalized Completely Hausdorff, Generalized Paracompact.

AMS Subject Classification
18F60.

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Contents

1. Introduction

One of the important development of general topology in recent years is the theory of generalized topological spaces defined by A. Csaszar [2]. In particular, he introduced the basic operators in generalized topology. Noiri and B. Roy [1] in 2011 introduced a new kind of sets called generalized μ-closed set in a topological space by using the concept of generalized μ-open set introduced by Csaszar. In 2011, M. S. Sarsak [13] studied separation axioms and B. Roy [1] introduced regularity and normality on generalized topological spaces using generalized μ-closed and μ-open sets. Samirah A. Alzahrani[12] introduced the concept of epiregularity in topological spaces and studied its topological properties. We introduced the concept of epiregular space in generalized topology and studied some of its basic properties using the concept of generalized μ-open and generalized μ-closed sets.

2. Preliminaries

In this section, we recall some definitions and basic results used throughout the paper.

Definition 2.1. *[14] Let topology τ on a set Y contains another topology τ' on Y (that is, every member of τ' is a member of τ), we say that τ is a stronger or finer topology than τ', or that τ' is a weaker or coarser topology than τ.*

Definition 2.2. *[3] A generalized topological space (Y, μ) is said to be generalized paracompact if every μ-open covering of Y has μ-locally finite μ-open refinement that covers Y.*

Definition 2.3. *[4] A generalized topological space (Y, μ) is said to be generalized Hausdorff if for any two distinct points m and n, there exists disjoint μ-open sets A and B such that m $\in$ A and n $\in$ B.*

Definition 2.4. *[1] A generalized topological space (Y, μ) is said to be generalized regular (generalized T_3) if for each μ-closed set F of Y not containing m, there exist disjoint μ-open sets A and B such that m $\in$ A and F $\subseteq$ B.*

Definition 2.5. *[1] A generalized topological space (Y, μ) is generalized normal (generalized T_4) if for any pair of disjoint μ-closed subsets G and H of Y, there exist disjoint μ-open sets A and B such that G $\subseteq$ A and H $\subseteq$ B.*

3. Generalized Epiregularity

Definition 3.1. *A generalized topological space (Y, μ) is called generalized epiregular if there is a generalized coarser topology (Y, μ') on Y such that (Y, μ') is generalized T_3.*

Example 3.2. *Let $Y = \{p, q, r\}$, $\mu = \{\phi, \{p\}, \{q\}, \{r\}, \{p,q\}, \{q,r\}, \{p,r\}, \{p,q,r\}\}$*
and $\mu' = \{\phi, \{p\}, \{q\}, \{p,q\}, \{q,r\}, \{p,q,r\}\}$. Hence (Y, μ') is generalized T_3 (generalized regular Hausdorff) space. Here (Y, μ) is generalized epiregular.

Theorem 3.3. *Every generalized epiregular space is generalized Hausdorff.*

Proof. Proof directly follows from the definition 3.1. □

Remark 3.4. *Converse of the above theorem need not be true which is given in the following example.*

Example 3.5. *Let $Y = \{p, q\}$ and $\mu = \{\phi, Y, \{p\}, \{q\}, \{r\}, \{p, q\}\}$. Here (Y, μ) is generalized Hausdorff but it is not generalised epiregular. Here there does not exist coarser topology (Y, μ') such that (Y, μ') is generalized T_3.*

Definition 3.6. *A generalized topological space (Y, μ) is said to be generalized completely Hausdorff if for any $x \neq y$, there exists disjoint μ-open sets A and B such that $x \in cl\,(A)$, $y \in cl\,(B)$.*

Theorem 3.7. *Every generalized epiregular space is generalized completely Hausdorff.*

Proof. Let (Y, μ) be any generalized epiregular space, and let m, n be any two distinct points in Y, then there exists generalized coarser topology μ' on Y such that (Y, μ') is generalized T_3. By generalized T_2 of μ', there exists P, Q $\in (Y, \mu')$ such that $m \in P$, $n \in Q$ and $P \cap Q = \phi$. Also by generalized regularity of μ', there exists A, B $\in (Y, \mu')$ such that $m \in A \subseteq (cl(A))^{\mu'} \subseteq P$ and $n \in B \subseteq (cl(B))^{\mu'} \subseteq Q$, where $(cl(A))^{\mu'} = \{m \in Y : D \cap A \neq \phi, \forall \text{ open } D \text{ in } (Y, \mu'), m \in D\}$ similarly $(cl(B))^{\mu'}$. Since $(cl(G))^{\mu} \subseteq (cl(G))^{\mu'}$, for any G $\subseteq$ Y, this implies that $(cl(A))^{\mu} \subseteq (cl(A))^{\mu'}$. As $(cl(A))^{\mu'} \cap (cl(B))^{\mu'} = \phi$ then $(cl(A))^{\mu} \cap (cl(B))^{\mu} = \phi$. Thus (Y, μ) is generalized completely Hausdorff. □

Remark 3.8. *Converse of the above theorem need not be true which is given in the following example.*

Example 3.9. *Let $Y = \{q, r\}$ and $\mu = \{\phi, \{q\}, \{r\}, \{q, r\}\}$. Here (Y, μ) is generalized completely Hausdorff but it is not generalized epiregular. Here there does not exist coarser topology (Y, μ') such that (Y, μ') is generalized T_3.*

Theorem 3.10. *If the generalized coarser topology (Y, μ') of the generalized epiregular space (Y, μ) is generalized paracompact, then (Y, μ) is generalized T_4.*

Proof. Proof of the theorem follows definition from 2.3 and 2.4. □

Theorem 3.11. *Any generalized epiregular compact space is generalized T_4.*

Proof. Let the generalized epiregular compact space be (Y, μ) then generalized coarser topology (Y, μ') is generalized T_3 which implies that it is generalized T_2. Also every generalized epiregular compact space is generalized T_4. □

Theorem 3.12. *In an generalized epiregular space, for every generalized compact set G and every $m \notin G$, there exist disjoint μ-open sets A, B such that $G \subseteq A$ and $m \in B$.*

Proof. Let (Y, μ) be generalized epiregular space, then there exists a generalized coarser topology μ' on Y such that (Y, μ') is generalized T_3. Let G be any generalized compact set in (Y, μ) and let $m \notin G$, hence G is μ-closed in (Y, μ') and $m \notin G$, by generalized regularity of (Y, μ'), there exists A, B $\in \mu'$ such that $G \subseteq A$, $m \in B$ and $A \cap B = \phi$. □

Theorem 3.13. *If G and H are disjoint generalized compact sets in an generalized epiregular space (Y, μ), then there exists disjoint μ-open sets A and B such that $G \subseteq A$, $H \subseteq B$.*

Proof. Let (Y, μ) be generalized epiregular space, then there exists a generalized coarser topology μ' on Y such that (Y, μ') is generalized T_3. Let G, H be any disjoint generalized compact subsets of (Y, μ), hence they are disjoint generalized compact subsets of (Y, μ') and by theorem 3.10 for each $p \in$ G and generalized compact set H, there exist μ-open sets A_a, B_a such that $p \in A_a$, $H \subseteq B_a$ and $A_a \cap B_a = \phi$. Now consider G as an arbitrary generalized compact set disjoint from H. (By theorem 3.10), for each p in G, disjoint μ-open set A_{a_i} containing p and B_{a_i} containing H, such that A $= \cup_{i=1}^n A_{a_i}$ is μ-open set containing G and disjoint from B $= \cap_{i=1}^n B_{a_i}$ which is a μ-open set containing H. □

Theorem 3.14. *Generalized epiregularity is a generalized topological property.*

Proof. Let (Y, μ) be generalized epiregular space. Assume that $(X, \mu_1) \cong (X, \mu_2)$. Let μ_1' be a generalized coarser topology on Y such that (Y, μ_1') is generalized T_3. Let f : $(Y, \mu_1) \rightarrow (X, \mu_2)$ be a generalized homeomorphism. Define a generalized topology μ_2' on by $(X, \mu_2') = \{f(A) : A \in \mu_1'\}$. Then μ_2' is a coarser than μ_2 and (X, μ_2') is generalized T_3. Hence (X, μ_2) is generalized epiregular. □

Theorem 3.15. *Generalized epiregularity is a generalized hereditary property.*

Proof. Let (Y, μ) be generalized epiregular space, and let (X, μ_X) be a subspace of (Y, μ). Let μ' be a generalized coarser topology on Y such that (Y, μ') is generalized T_3. Since generalized T_3 is generalized hereditary, (X, μ_X') is generalized T_3 and $\mu_X' \subseteq \mu_X$. Therefore (X, μ_X) is generalized epiregular. □

Theorem 3.16. *Generalized epiregular is an generalized additive property.*

Proof. Let (Y_α, μ_α) be an generalized epiregular space for each $\alpha \in \Lambda$, let μ_α', be a generalized coarser topology on Y_α, coarser than μ_α such that (Y_α, μ_α') is generalized T_3. Since generalized T_1 and generalized epiregularity are both generalized additive, $\oplus_{\alpha \in \Lambda} (Y_\alpha, \mu_\alpha')$ is generalized T_3, and its generalized topology is coarser than the generalized topology on $\oplus_{\alpha \in \Lambda} (Y_\alpha, \mu_\alpha)$. □

Theorem 3.17. *Let $\{(Y_\alpha, \mu_\alpha) : \alpha \in \Lambda\}$ be a family of generalized topological spaces, and let $Y = \Pi_{\alpha \in \Lambda} Y_\alpha$. Then (Y, μ) is generalized epiregular, where μ is the Tychonoff product*

generalized topology, if and only if (Y_α, μ_α) is generalized epiregular for each $\alpha \in \Lambda$.

Proof. Assume (Y, μ) is generalized epiregular, and let $\beta \in \Lambda$, by theorem 3.13, every subspace of (Y, μ) is generalized epiregular. Then there is a subspace of (Y, μ) that is generalized homeomorphic to (Y_β, μ_β). Since generalized epiregularity is a generalized topological property (Y_β, μ_β) is generalized epiregular. Assume (Y_α, μ_α) is generalized epiregular space for each $\alpha \in \Lambda$, let μ'_α be a generalized topology on Y_α, coarser than μ_α such that (Y_α, μ'_α) is generalized T_3. Since generalized T_3 is multiplicative, $\Pi_{\alpha \in \Lambda} Y_\alpha$ is generalized T_3 with respect of the generalized product topology of μ'_α's, and its generalized topology is coarser than the generalized topology on $\Pi_{\alpha \in \Lambda} (Y_\alpha, \mu_\alpha)$. Hence (Y, μ), $Y = \Pi_{\alpha \in \Lambda} Y_\alpha$ is generalized epiregular. $\square$

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ON NANO GENERALIZED PRE *c*-CONTINUOUS FUNCTIONS IN NANO TOPOLOGICAL SPACES

P. PADMAVATHI[1] AND R. NITHYAKALA

ABSTRACT. The purpose of this paper is to introduce a new class of continuous functions called Nano generalized pre c-continuous functions in Nano Topological Spaces and derive their characterizations in terms of nano generalized pre c-closure, nano generalized pre c-interior, nano generalized pre c-kernel and nano generalized pre c-surface.

1. INTRODUCTION

Continuous functions play a major role in general topology. Several authors have studied different types of generalization of continuous functions. Lellis Thivagar and Carmel Richard [1] introduced the notion of Nano Topology with respect to a subset X of a universe which is defined in terms of approximations and boundary region. They defined nano closed sets, nano interior and nano closure. They [2] also introduced nano continuous functions, nano open maps, nano closed maps and nano homeomorphisms in nano topological spaces. Padmavathi and Nithyakala [4] introduced nano generalized pre c-closed sets.

In this paper we have introduced a new class of continuous functions called nano generalized pre c continuous functions and established some of their representations in terms of nano interior, nano closure, nano kernel, nano generalized pre c-interior, nano generalized pre c-closure, nano generalized pre c-kernel and nano generalized pre c-surface of sets.

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2. Preliminaries

Definition 2.1. *[1] Let U be a non empty finite set of objects called the universe and R be an equivalence relation on U named as indiscernibility relation. Then U is divided into disjoint equivalence classes. Elements belonging to the same equivalence class are said to be indiscernible with one another. The pair (U, R) is said to be approximation space. Let $X \subseteq U$. Then*

(1) *The lower approximation of X with respect to R is the set of all objects, which can be for certain classified as X with respect to R and is denoted by $L_R(X)$. $L_R(X) = \bigcup_{x \in U} \{R(x) : R(x) \subseteq X\}$ where $R(x)$ denotes the equivalence class determined by $L_R(X)$.*

(2) *The upper approximation of X with respect to R is the set of all objects which can be possibly classified as X with respect to R and is denoted by $U_R(X)$. $U_R(X) = \bigcup_{x \in U} \{R(x) : R(x) \cap X \neq \emptyset\}$.*

(3) *The boundary region of X with respect to R is the set of all objects which can be classified neither as X nor as not-X with respect to R and it is denoted by $B_R(X)$. $B_R(X) = U_R(X) - L_R(X)$.*

Proposition 2.1. *[1] If (U, R) is an approximation space and $X, Y \subseteq U$, then*

(1) $L_R(X) \subseteq X \subseteq U_R(X)$

(2) $L_R(\emptyset) = U_R(\emptyset) = \emptyset$

(3) $L_R(U) = U_R(U) = U$

(4) $U_R(X \bigcup Y) = U_R(X) \bigcup U_R(Y)$

(5) $U_R(X \bigcap Y) \subseteq U_R(X) \bigcap U_R(Y)$

(6) $L_R(X \bigcup Y) \supseteq L_R(X) \bigcup L_R(Y)$

(7) $L_R(X \bigcap Y) = L_R(X) \bigcap L_R(Y)$

(8) $L_R(X) \subseteq L_R(Y)$ *and* $U_R(X) \subseteq U_R(Y)$ *whenever* $X \subseteq Y$

(9) $U_R(X^c) = [L_R(X)]^c$ *and* $L_R(X^c) = [U_R(X)]^c$

(10) $U_R[U_R(X)] = L_R[U_R(X)] = U_R(X)$

(11) $L_R[L_R(X)] = U_R[L_R(X)] = L_R(X)$.

Definition 2.2. *[1] Let U be the universe, R be an equivalence relation on U as $\tau_R(X) = \{U, \emptyset, L_R(X), U_R(X), B_R(X)\}$ where $X \subseteq U$. Then $\tau_R(X)$ satisfies the following axioms.*

- *U and $\emptyset \in \tau_R(X)$.*
- *The union of all the elements of any sub-collection of $\tau_R(X)$ is in $\tau_R(X)$.*

- *The intersection of the elements of any finite sub collection of $\tau_R(X)$ is in $\tau_R(X)$.*

Then $\tau_R(X)$ is a topology on U called the nano topology on U with respect to X. We call $(U, \tau_R(X))$ as a nano topological space. The elements of $\tau_R(X)$ are called as nano open sets. The complement of the nano open sets are called nano closed sets.

Remark 2.1. *[1] If $\tau_R(X)$ is a nano topology on U with respect to X, then the set $B = \{U, L_R(X), B_R(X)\}$ is the basis for $\tau_R(X)$.*

Definition 2.3. *[1] If $(U, \tau_R(X))$ is a nano topological space with respect to X where $X \subseteq U$ and if $A \subseteq U$ then*

(1) *The nano interior of A is defined as the union of all nano open subsets contained in A and is denoted by $Nint(A)$.*
(2) *The nano closure of A is defined as the intersection of all nano closed sets containing A and is denoted by $Ncl(A)$.*

Definition 2.4. *[3] Let $(U, \tau_R(X))$ be a nano topological space and $A \subseteq U$. The set $Nker(A) = \cap\{U : A \subseteq U, U \in \tau_R(X)\}$ is called the nano kernel of A and is denoted by $Nker(A)$.*

3. Nano Generalized pre c-Continuous Functions

In this section, we define nano generalized pre c-continuous function and study its characterization with Ngpc-int, Ngpc-cl, Ngpc-ker and Ngpc-surf of sets.

Definition 3.1. *Let $(U, \tau_R(X))$ and $(V, \tau'_R(Y))$ be two nano topological spaces. The function $f : (U, \tau_R(X)) \to (V, \tau'_R(Y))$ is said to be Nano generalized pre c-continuous (briefly Ngpc- continuous) on U if the inverse image of every nano open set in V is a Ngpc-open set in U.*

Example 1. *Let $U = \{a, b, c, d\}$ with $\frac{U}{R} = \{\{a\}, \{b\}, \{c, d\}\}$ and $X = \{b, d\}$. Then $\tau_R(X) = \{\emptyset, U, \{b\}, \{c, d\}, \{b, c, d\}\}$ is a nano topology on U. Let $V = \{x, y, z, w\}$ with $V/R' = \{\{x\}, \{z\}, \{y, w\}\}$ and $Y = \{x, y\}$. Then $\tau'_R(Y) = \{\emptyset, V, \{x\}, \{y, w\}, \{x, y, w\}\}$ is a nano topology on V.*

Then $\tau_R^C(X) = \{\emptyset, U, \{a\}, \{a,b\}, \{a,c,d\}\}$ *and* $\tau_{R'}^C(Y) = \{\emptyset, V, \{z\}, \{x,z\}, \{y,z,w\}\}$ *are the complements of* $\tau_R(X)$ *and* $\tau_R'(Y)$ *respectively.*

Define $f : (U, \tau_R(X)) \to (V, \tau_R'(Y))$ *as* $f(a) = z, f(b) = y, f(c) = x, f(d) = w$. *Then* $f^{-1}(\{x\}) = \{c\}, f^{-1}(\{y,w\}) = \{b,d\}, f^{-1}(\{x,y,w\}) = \{b,c,d\}$. *Thus the inverse image of every nano open set in* V *is Ngpc-open in* U.

Definition 3.2. *The Nano generalized pre c-surface of* A *is defined as the union of all Ngpc-closed sets of* U *contained in* A *and it is denoted by Ngpc-surf(A).*

Example 2. *Let* $U = \{a,b,c,d\}$ *with* $\frac{U}{R} = \{\{a\}, \{b\}, \{c,d\}\}$ *and* $X = \{b,d\}$. *Then* $\tau_R(X) = \{\emptyset, U, \{b\}, \{c,d\}, \{b,c,d\}\}$ *is a nano topology with respect to* X *and the complement* $\tau_R(X)^c = \{\emptyset, U, \{a\}, \{a,b\}, \{a,c,d\}\}$.

Then Ngpc-surf$(\{a\}) = \{a\}$, Ngpc-surf$(\{b\}) = \phi$ and Ngpc-surf$(\{a,c\}) = \{a,c\}$.

Theorem 3.1. *A function* $f : (U, \tau_R(X)) \to (V, \tau_R'(Y))$ *is Ngpc-continuous iff the inverse image of every nano closed set in* V *is Ngpc-closed in* U.

Proof. Let f be Ngpc-continuous. Let A be a nano closed set in V. Then $V - A$ is nano open in V. Since f is Ngpc-continuous, $f^{-1}(V - A)$ is Ngpc-open in U. That is $U - f^{-1}(A)$ is Ngpc-open in U. Therefore $f^{-1}(A)$ is Ngpc closed in U. Thus the inverse image of every nano closed set in V is Ngpc-closed in U if f is Ngpc-continuous. Conversely, let the inverse image of every nano closed set in V is Ngpc-closed in U. Let B be a nano open set in V. Then $V - B$ is nano closed in V. Then $f^{-1}(V - B)$ is Ngpc-closed in U. That is $U - f^{-1}(B)$ is Ngpc-closed in U. Therefore $f^{-1}(B)$ is Ngpc open in U. Hence f is Ngpc-continuous. $\square$

Theorem 3.2. *Let* $f : (U, \tau_R(X)) \to (V, \tau_R'(Y))$ *be a function. Then the following statements are equivalent.*

  (i) *f is Ngpc-continuous.*
 (ii) *For every subset A of U, $f(Ngpc - cl(A)) \subseteq Ncl(f(A))$.*
(iii) *For every subset B of V, Ngpc-cl$(f^{-1}(B)) \subseteq f^{-1}(Ncl(B))$.*

Proof.

(i) $\Leftrightarrow$ (ii). Let f be Ngpc-continuous and $A \subseteq U$. Then $f(A) \subseteq V$. $Ncl(f(A))$ is nano closed in V. Since f is Ngpc-continuous, $f^{-1}(Ncl(f(A)))$ is Ngpc-closed in U. Since $f(A) \subseteq Ncl(f(A))$, $A \subseteq f^{-1}(Ncl(f(A)))$. $f^{-1}(Ncl(f(A)))$ is a Ngpc-closed set containing A. But Ngpc-cl(A) is the smallest Ngpc-closed set containing A. Therefore Ngpc-cl$(A) \subseteq f^{-1}(Ncl(f(A)))$. That is $f(Ngpc - cl(A)) \subseteq Ncl(f(A))$.

Conversely let $f(Ngpc - cl(A)) \subseteq Ncl(f(A))$ for every subset A of U. Let G be a nano closed set in V. Since $f^{-1}(G) \subseteq U, f(Ngpc - cl(f^{-1}(G))) \subseteq Ncl(f(f^{-1}(G))) = Ncl(G)$. That is Ngpc-cl$(f^{-1}(G)) \subseteq f^{-1}(Ncl(G)) = f^{-1}(G)$ since G is nano closed. Hence Ngpc-cl$(f^{-1}(G)) \subseteq f^{-1}(G)$. But $f^{-1}(G) \subseteq Ngpc - cl(f^{-1}(G))$. Therefore $f^{-1}(G) = Ngpc - cl(f^{-1}(G))$. This implies $f^{-1}(G)$ is Ngpc-closed in U. Thus the inverse image of every nano closed set in V is Ngpc-closed in U. Hence f is Ngpc-continuous.

(ii) $\Leftrightarrow$ (iii). Assume (ii) holds. Let B be any subset of V. Then replacing A by $f^{-1}(B)$ in (ii) we have $f(Ngpc - cl(f^{-1}(B))) \subseteq Ncl(f(f^{-1}(B))) = Ncl(B)$. That is Ngpc-cl$(f^{-1}(B)) \subseteq f^{-1}(Ncl(B))$.

Conversely suppose (iii) holds. Let A be any subset of U. Then $f(A) \subseteq V$. Let $B = f(A)$. Then we have Ngpc-cl$(A) = Ngpc - cl(f^{-1}(B)) \subseteq f^{-1}(Ncl(B)) = f^{-1}(Ncl(f(A)))$. This implies Ngpc-cl$(A) \subseteq f^{-1}(Ncl(f(A)))$. Thus $f(Ngpc - cl(A)) \subseteq Ncl(f(A))$. $\square$

Theorem 3.3. *Let* $f : (U, \tau_R(X)) \to (V, \tau'_R(Y))$ *be a function. Also let* $A \subseteq U$ *and* $B \subseteq V$. *Then*

    (i) *f is Ngpc-continuous* $\Leftrightarrow Nintf(A) \subseteq f(Ngpc - int(A)) \Leftrightarrow f^{-1}(Nint(B)) \subseteq Ngpc - int(f^{-1}(B))$.

    (ii) *f is Ngpc-continuous* $\Leftrightarrow A \subseteq Ngpc - int(f^{-1}Nker(f(A))) \Leftrightarrow f^{-1}(B) \subseteq Ngpc - int(f^{-1}(Nker(B)))$.

Proof. Proof is similar as theorem 3.2 $\square$

Theorem 3.4. *Let* $f : (U, \tau_R(X)) \to (V, \tau'_R(Y))$ *be Ngpc-continuous. Then for every subset* A *of* U *we have*

    (i) $f(Ngpc - surf(A)) \subseteq Ncl(f(A))$.
    (ii) $Nintf(A) \subseteq f(Ngpc - ker(A))$.
    (iii) $f(Ngpc - ker(A)) \subseteq Nker(f(A))$.

Proof. (i) Let f be Ngpc-continuous and $A \subseteq U$. Then $f(A) \subseteq V.Ncl(f(A))$ is nano closed in V. Since f is Ngpc-continuous, $f^{-1}(Ncl(f(A)))$ is Ngpc-closed in U. Therefore Ngpc-surf $(f^{-1}(Ncl(f(A)))) = f^{-1}(Ncl(f(A)))$. But we know that $f(A) \subseteq Ncl(f(A)), A \subseteq f^{-1}(Ncl(f(A)))$ which implies Ngpc-surf $A \subseteq Ngpc - surf(f^{-1}(Ncl(f(A))))$. Hence Ngpc-surf $(A) \subseteq f^{-1}(Ncl(f(A)))$. That is $f(Ngpc - surf(A)) \subseteq Ncl(f(A))$. Proof of (ii) and (iii) are similar. $\square$

4. Nano Contra Generalized pre c-Continuous functions

In this section, we define nano contra generalized pre c-continuous function and study its characterization with Ngpc-int and Ngpc-cl of sets.

Definition 4.1. *Let $(U, \tau_R(X))$ and $(V, \tau'_R(Y))$ be two nano topological spaces. The function $f : (U, \tau_R(X)) \to (V, \tau'_R(Y))$ is said to be Nano contra generalized pre c-continuous (briefly Ncgpc-continuous) on U if the inverse image of every nano open set in V is Ngpc-closed in U.*

Example 3. *In Example 1, Define $f : (U, \tau_R(X)) \to (V, \tau'_R(Y))$ as $f(a) = w$, $f(b) = y$, $f(c) = x$, $f(d) = z$. Then $f^{-1}(\{x\}) = \{c\}, f^{-1}(\{y, w\}) = \{a, b\}, f^{-1}(\{x, y, w\}) = \{a, b, c\}$. The inverse image of every nano open set in V is Ngpc-closed in U.*

Theorem 4.1. *A function $f : (U, \tau_R(X)) \to (V, \tau'_R(Y))$ is Ncgpc-continuous iff the inverse image of every nano closed set in V is Ngpc-open in U.*

Proof. Let f be Ncgpc-continuous. Let A be a nano closed set in V. Then $V - A$ is nano open in V. Since f is Ncgpc-continuous, $f^{-1}(V - A) = U - f^{-1}(A)$ is Ngpc-closed in U. Therefore $f^{-1}(A)$ is Ngpc-open in U. Thus the inverse image of every nano closed set in V is Ngpc-open in U. Conversely, assume that the inverse image of every nano closed set in V is Ngpc-open in U. Let B be a nano open set in V. Then $V - B$ is nano closed in V. By our assumption $f^{-1}(V - B) = U - f^{-1}(B)$ is Ngpc-open in U. Therefore $f^{-1}(B)$ is Ngpc-closed in U. That is the inverse image of every nano open set in V is a Ngpc-closed set in U. Hence f is Ncgpc-continuous. $\qquad\square$

Theorem 4.2. *Let $f : (U, \tau_R(X)) \to (V, \tau'_R(Y))$ be a function. Then the following statements are equivalent.*

(i) *f is Ncgpc-continuous.*
(ii) *For every subset A of U, $f(Ngpc - cl(A)) \subseteq Nker(f(A))$.*
(iii) *For every subset B of V, $Ngpc - cl(f^{-1}(B)) \subseteq f^{-1}(Nker(B))$.*

Proof.

(i) $\Rightarrow$ (ii). Let f be Ncgpc-continuous and $A \subseteq U$. Then $f(A) \subseteq V$. $Nker(f(A))$ is nano open in V. Since f is Ncgpc-continuous, $f^{-1}(Nker(f(A)))$ is Ngpc-closed in U. Since $f(A) \subseteq Nker(f(A)), A \subseteq f^{-1}(Nker(f(A)))$. $f^{-1}(Nker(f(A)))$

is a Ngpc-closed set containing A. But $Ngpc - cl(A)$ is the smallest Ngpc-closed set containing A. Therefore $Ngpc - cl(A) \subseteq f^{-1}(Nker(f(A)))$. That is $f(Ngpc - cl(A)) \subseteq Nker(f(A))$.

(ii) $\Rightarrow$ (iii). Assume (ii) holds. Let B be any subset of V. Then $f^{-1}(B) \subseteq U$. By our assumption $f(Ngpc - cl(f^{-1}(B))) \subseteq Nker(f(f^{-1}(B))) = Nker(B)$. That is Ngpc-$cl(f^{-1}(B)) \subseteq f^{-1}(Nker(B))$.

(iii) $\Rightarrow$ (i). Suppose (iii) holds. Let G be a nano open subset of V. Then by our assumption Ngpc-$cl(f^{-1}(G)) \subseteq f^{-1}(Nker(G)) = f^{-1}(G)$. But we know that $f^{-1}(G) \subseteq Ngpc - cl(f^{-1}(G))$. That is Ngpc-$cl(f^{-1}(G)) = f^{-1}(G)$ implies $f^{-1}(G)$ is Ngpc-closed in U. Therefore f is Ncgpc continuous. $\square$

Theorem 4.3. *Let $f : U \to V$ be a function. Also let $A \subseteq U$ and $B \subseteq V$. Then we have*

(1) *f is Ncgpc-continuous $\Leftrightarrow$ Ngpc-cl($f^{-1}(Nint(f(A))))) \subseteq A$*
    $\Leftrightarrow$ Ngpc-cl($f^{-1}(Nint(B)) \subseteq f^{-1}(B)$).
(2) *f is Ncgpc-continuous $\Leftrightarrow A \subseteq$ Ngpc-int $f^{-1}(Ncl\, f(A)))$*
    $\Leftrightarrow f^{-1}(B) \subseteq$ Ngpc-int $(f^{-1}(Ncl(B)))$.

Proof. Proof is similar as theorem 4.2. $\square$

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Elimination of Attributes in Chronic Kidney Disease using Basis in Nano Topology

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Abstract

The main objective of this paper is to apply eliminination of attributes in information systems through nano topological spaces. The risk factors that cause chronic kidney disease are identified by generating the basis in nano topological spaces.

Keywords: Nano topological space, basis, attributes.

1. Introduction

Chronic kidney disease also called chronic kidney failure describes the gradual loss of kidney function. The disease is chronic because the damage to the kidney happens slowly over a long period of time. Kidneys filters wastes and excess fluids from the body, which are then excreted. When chronic kidney disease reaches an advanced stage, dangerous levels of fluid, electrolytes and wastes build up in the body. Treatment for chronic kidney disease focuses on slowing the progression of the kidney damage, by controlling the underlying cause. Chronic kidney disease can progress to end stage kidney failure which is fatal without artificial filtering or a kidney transplant. In this paper an attempt is made to identify the risk factors that cause chronic kidney disease from the information among some patients.

2. Preliminaries

We recall the following definitions.

Definition 2.1. [2] Let U be a non empty finite set of objects called the universe and R be an equivalence relation on U named as indiscernibility relation. Then U is divided into disjoint equivalence classes. Elements belonging to the same equivalence class are said to be indiscernible with one another. The pair (U,R) is said to be approximation space. Let $X \subseteq$ U. Then

(i)   The lower approximation of X with respect to R is the set of all objects, which can be for certain classified as X with respect to R and is denoted by $L_R(X)$.

$$L_R(X) = \bigcup_{x \in U} \{R(x) : R(x) \subseteq X\}$$ where R(x) denotes the equivalence class determined by $L_R(X)$.

(ii)   The upper approximation of X with respect to R is the set of all objects which can be possibly classified as X with respect to R and is denoted by $U_R(X)$.

$$U_R(X) = \bigcup_{x \in U} \{R(x) : R(x) \cap X \neq \emptyset\} .$$

(iii)   The boundary region of X with respect to R is the set of all objects which can be classified neither as X nor as not-X with respect to R and it is denoted by $B_R(X)$.

$$B_R(X) = U_R(X) - L_R(X).$$

Remark 2.2. [2] If $\tau_R(X)$ is a nano topology on U with respect to X, then the set B = $\{U, L_R(X), B_R(X)\}$ is the basis for $\tau_R(X)$.

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Patients	Diabetes	Smoking and Alcohol	Hypertension	Obesity	Family History	CKD
1	√	√	✗	√	✗	Sure
2	√	✗	√	✗	√	Sure
3	✗	√	✗	√	✗	Not Sure
4	√	√	✗	√	✗	Not Sure
5	✗	√	√	√	✗	Sure
6	√	√	√	√	✗	Sure
7	✗	√	√	√	✗	Not Sure
8	√	✗	✗	✗	√	Not Sure

3. Application of Nanotopology in Elimination of Attributes

Table 1

3.1 Algorithm

Step 1: For a limited Universe U, a limited set of attributes A which is partitioned in to two classes S and D and an equivalence relation R on U corresponding to S.

Step 2: Find the lower boundary, upper boundary and boundary region with respect to R.

Step 3: Generate the Nanotopology $\tau_S(X)$ and its basis $\beta_S(X)$.

Step 4: Eliminate an attribute Y from S and determine lower boundary, upper boundary and boundary region for S-Y.

Step 5: Generate the Nanotopology $\tau_{S-Y}(X)$ and its basis $\beta_{S-Y}(X)$.

Step 6: Repeat steps 4 and 5 for each attribute.

Step 7: The CORE attributes are those for which $\beta_S(X) \neq \beta_{S-Y}(X)$.

Step 8: Eliminate an attribute not in CORE. Repeat steps 4 to 7 and determine the CORE in all the cases.

Step 9: The attributes in CORE are the risk factors that cause the disease.

The concept of elimination of attributes in Nano Topology is applied to identify the key factors that cause Chronic Kidney Disease. Consider the table 1 which gives the information about patients having Diabetes, Smoking and Alcohol, Hypertension, Obesity and Family History.

Here the set of patients is $U = \{1,2,3,4,5,6,7,8\}$ and $A = \{$Diabetes, Smoking and Alcohol, Hypertension, Obesity, Family History and Chronic kidney disease$\}$. A is classified into two classes $S = \{$DB, SA, HT, OB, FH$\}$ and $D = \{$Chronic Kidney Disease$\}$. The family of equivalence classes U/S corresponding to S is given by $U/R(S) = \{1,4\}, \{2\}, \{3\}, \{5,7\}, \{6\}, \{8\}\}$.

Case I. Patients with Chronic Kidney Disease:

Here the set of patients with CKD is $X = \{1,2,5,6\}$. Then $LB_S(X) = \{2,6\}$, $UB_S(X) = \{1,2,4,5,6,7\}$ and $BR_S(X) = \{1,4,5,7\}$ .Therefore the nano topology on U is given by $\tau_S(X) = \{\emptyset, U, \{2,6\}, \{1,4,5,7\}, \{1,2,4,5,6,7\}\}$ and the basis is given by $\beta_S(X) = \{\emptyset, U, \{2,6\}, \{1,4,5,7\}\}$. The issue is to find the key factors that cause chronic kidney disease.

Step 1:

When the attribute DB is deleted from S, $U/R(S - DB) = \{1,3,4\}, \{2\}, \{5,6,7\}, \{8\}\}$ and hence $LB_{S-DB}(X) = \{2\}$, $UB_{S-DB}(X) = \{1,2,3,4,5,6,7\}$ and $BR_{S-DB}(X) = \{1,3,4,5,6,7\}$. The corresponding nano topology and its basis are given by $\tau_{S-DB}(X) = \{\emptyset, U, \{2\}, \{1,3,4,5,6,7\}, \{1,2,3,4,5,6,7\}\}$ and $\beta_{S-DB}(X) = \{\emptyset, U, \{2\}, \{1,3,4,5,6,7\}\} \neq \beta_S(X)$.

If the attribute SA is removed from S, $U/R(S - SA) = \{1,4\}, \{2\}, \{3\}, \{5,7\}, \{6\}, \{8\}\}$ then

$LB_{S-SA}(X) = \{2,6\}$, $UB_{S-SA}(X) = \{1,2,4,5,6,7\}$ and $BR_{S-SA}(X) = \{1,4,5,7\}$. The corresponding nano topology and its basis are given by $\tau_{S-SA}(X) = \{\emptyset, U, \{2,6\}, \{1,4,5,7\}, \{1,2,4,5,6,7\}\}$ and $\beta_{S-SA}(X) = \{\emptyset, U, \{2,6\}, \{1,4,5,7\}\} = \beta_S(X)$.

When the attribute HT is ignored from S, $U/R(S-HT) = \{1,4,6\}, \{2,8\}, \{3,5,7\}\}$ and hence

$LB_{S-HT}(X) = \{\emptyset\}$, $UB_{S-HT}(X) = \{U\}$ and $BR_{S-HT}(X) = \{U\}$. The corresponding nano topology and its basis are given by $\tau_{S-HT}(X) = \{\emptyset, U\}$ and $\beta_{S-HT}(X) = \{\emptyset, U\} \neq \beta_S(X)$.

If the attribute OB is removed from S, $U/R(S-OB) = \{1,4\}, \{2\}, \{3\}, \{5,7\}, \{6\}, \{8\}\}$ then

$LB_{S-OB}(X) = \{2,6\}$, $UB_{S-OB}(X) = \{1,2,4,5,6,7\}$ and $BR_{S-OB}(X) = \{1,4,5,7\}$. The corresponding nano topology and its basis are given by $\tau_{S-OB}(X) = \{\emptyset, U, \{2,6\}, \{1,4,5,7\}, \{1,2,4,5,6,7\}\}$ and $\beta_{S-OB}(X) = \{\emptyset, U, \{2,6\}, \{1,4,5,7\}\} = \beta_S(X)$.

If the attribute FH is deleted from S, $U/R(S-FH) = \{1,4\}, \{2\}, \{3\}, \{5,7\}, \{6\}, \{8\}\}$ and therefore

$LB_{S-FH}(X) = \{2,6\}$, $UB_{S-FH}(X) = \{1,2,4,5,6,7\}$ and $BR_{S-FH}(X) = \{1,4,5,7\}$. The corresponding nano topology and its basis are given by $\tau_{S-FH}(X) = \{\emptyset, U, \{2,6\}, \{1,4,5,7\}, \{1,2,4,5,6,7\}\}$ and $\beta_{S-FH}(X) = \{\emptyset, U, \{2,6\}, \{1,4,5,7\}\} = \beta_S(X)$. Therefore CORE = {Diabetes, Hypertension}.

Step 2:

Let T = S-SA = {DB, HT, OB, FH},then $\beta_T(X) = \beta_S(X)$.

When the attribute DB is deleted from T, $U/R(T-DB) = \{1,3,4\}, \{2\}, \{5,6,7\}, \{8\}\}$ and hence

$LB_{T-DB}(X) = \{2\}$, $UB_{T-DB}(X) = \{1,2,3,4,5,6,7\}$ and $BR_{T-DB}(X) = \{1,3,4,5,6,7\}$. The corresponding nano topology and its basis are given by $\tau_{T-DB}(X) = \{\emptyset, U, \{2\}, \{1,3,4,5,6,7\}, \{1,2,3,4,5,6,7\}\}$ and $\beta_{T-DB}(X) = \{\emptyset, U, \{2\}, \{1,3,4,5,6,7\}\} \neq \beta_S(X)$.

When the attribute HT is ignored from T, $U/R(T-HT) = \{1,4,6\}, \{2,8\}, \{3,5,7\}\}$ and hence

$LB_{T-HT}(X) = \{\emptyset\}$, $UB_{T-HT}(X) = \{U\}$ and $BR_{T-HT}(X) = \{U\}$. The corresponding nano topology and its basis are given by $\tau_{T-HT}(X) = \{\emptyset, U\}$ and $\beta_{T-HT}(X) = \{\emptyset, U\} \neq \beta_S(X)$.

If the attribute OB is removed from T, $U/R(T-OB) = \{1,4\}, \{2\}, \{3\}, \{5,7\}, \{6\}, \{8\}\}$ then

$LB_{T-OB}(X) = \{2,6\}$, $UB_{T-OB}(X) = \{1,2,4,5,6,7\}$ and $BR_{T-OB}(X) = \{1,4,5,7\}$. The corresponding nano topology and its basis are given by $\tau_{T-OB}(X) = \{\emptyset, U, \{2,6\}, \{1,4,5,7\}, \{1,2,4,5,6,7\}\}$ and $\beta_{T-OB}(X) = \{\emptyset, U, \{2,6\}, \{1,4,5,7\}\} = \beta_S(X)$.

If the attribute FH is deleted from T, $U/R(T-FH) = \{1,4\}, \{2\}, \{3\}, \{5,7\}, \{6\}, \{8\}\}$ and so

$LB_{T-FH}(X) = \{2,6\}$, $UB_{T-FH}(X) = \{1,2,4,5,6,7\}$ and $BR_{T-FH}(X) = \{1,4,5,7\}$. The corresponding nano topology and its basis are given by $\tau_{T-FH}(X) = \{\emptyset, U, \{2,6\}, \{1,4,5,7\}, \{1,2,4,5,6,7\}\}$ and $\beta_{T-FH}(X) = \{\emptyset, U, \{2,6\}, \{1,4,5,7\}\} = \beta_S(X)$. Therefore CORE = {Diabetes, Hypertension}.

Step 3:

Let V = S-SA = {DB, SA, HT, FH},then $\beta_V(X) = \beta_S(X)$.

When the attribute DB is deleted from V, $U/R(V-DB) = \{1,3,4\}, \{2\}, \{5,6,7\}, \{8\}\}$ and hence

$LB_{V-DB}(X) = \{2\}$, $UB_{V-DB}(X) = \{1,2,3,4,5,6,7\}$ and $BR_{V-DB}(X) = \{1,3,4,5,6,7\}$. The corresponding nano topology and its basis are given by $\tau_{V-DB}(X) = \{\emptyset, U, \{2\}, \{1,3,4,5,6,7\}, \{1,2,3,4,5,6,7\}\}$ and $\beta_{V-DB}(X) = \{\emptyset, U, \{2\}, \{1,3,4,5,6,7\}\} \neq \beta_S(X)$.

If the attribute SA is removed from V, $U/R(V-SA) = \{1,4\}, \{2\}, \{3\}, \{5,7\}, \{6\}, \{8\}\}$, then

$LB_{V-SA}(X) = \{2,6\}$, $UB_{V-SA}(X) = \{1,2,4,5,6,7\}$ and $BR_{V-SA}(X) = \{1,4,5,7\}$. The corresponding nano topology and its basis are given by $\tau_{V-SA}(X) = \{\emptyset, U, \{2,6\}, \{1,4,5,7\}, \{1,2,4,5,6,7\}\}$ and $\beta_{V-SA}(X) = \{\emptyset, U, \{2,6\}, \{1,4,5,7\}\} = \beta_S(X)$.

When the attribute HT is ignored from V, $U/R(V - HT) = \{1,4,6\},\{2,8\},\{3,5,7\}\}$ and therefore $LB_{V-HT}(X) = \{\emptyset\}$, $UB_{V-HT}(X) = \{U\}$ and $BR_{V-HT}(X) = \{U\}$. The corresponding nano topology and its basis are given by $\tau_{V-HT}(X) = \{\emptyset, U\}$ and $\beta_{V-HT}(X) = \{\emptyset, U\} \neq \beta_S(X)$.

If the attribute FH is deleted from V, $U/R(V - FH) = \{1,4\},\{2\},\{3\},\{5,7\},\{6\},\{8\}\}$, then $LB_{V-FH}(X) = \{2,6\}$, $UB_{V-FH}(X) = \{1,2,4,5,6,7\}$ and $BR_{V-FH}(X) = \{1,4,5,7\}$. The corresponding nano topology and its basis are given by $\tau_{V-FH}(X) = \{\emptyset, U, \{2,6\}, \{1,4,5,7\}, \{1,2,4,5,6,7\}\}$ and $\beta_{V-FH}(X) = \{\emptyset, U, \{2,6\}, \{1,4,5,7\}\} = \beta_S(X)$. Therefore CORE = {Diabetes, Hypertension}.

Step 4:

Let W = S-FH = {DB, SA, HT, OB}, then $\beta_W(X) = \beta_S(X)$.

When the attribute DB is deleted from W, $U/R(W - DB) = \{1,3,4\},\{2\},\{5,6,7\},\{8\}\}$ and hence $LB_{W-DB}(X) = \{2\}$, $UB_{W-DB}(X) = \{1,2,3,4,5,6,7\}$ and $BR_{W-DB}(X) = \{1,3,4,5,6,7\}$. The corresponding nano topology and its basis are given by $\tau_{W-DB}(X) = \{\emptyset, U, \{2\}, \{1,3,4,5,6,7\}, \{1,2,3,4,5,6,7\}\}$ and $\beta_{W-DB}(X) = \{\emptyset, U, \{2\}, \{1,3,4,5,6,7\}\} \neq \beta_S(X)$.

If the attribute SA is removed from W, $U/R(W - SA) = \{1,4\}, \{2\}, \{3\}, \{5,7\}, \{6\}, \{8\}\}$ then $LB_{W-SA}(X) = \{2,6\}$, $UB_{W-SA}(X) = \{1,2,4,5,6,7\}$ and $BR_{W-SA}(X) = \{1,4,5,7\}$. The corresponding nano topology and its basis are given by $\tau_{W-SA}(X) = \{\emptyset, U, \{2,6\}, \{1,4,5,7\}, \{1,2,4,5,6,7\}\}$ and $\beta_{W-SA}(X) = \{\emptyset, U, \{2,6\}, \{1,4,5,7\}\} = \beta_S(X)$.

When the attribute HT is ignored from W, $U/R(WT - HT) = \{1,4,6\}, \{2,8\}, \{3,5,7\}\}$, and therefore $LB_{W-HT}(X) = \{\emptyset\}$, $UB_{W-HT}(X) = \{U\}$ and $BR_{W-HT}(X) = \{U\}$. The corresponding nano topology and its basis are given by $\tau_{W-HT}(X) = \{\emptyset, U\}$ and $\beta_{W-HT}(X) = \{\emptyset, U\} \neq \beta_S(X)$.

If the attribute OB is removed from W, $U/R(W - OB) = \{1,4\}, \{2\}, \{3\}, \{5,7\}, \{6\}, \{8\}\}$ and therefore $LB_{W-OB}(X) = \{2,6\}$, $UB_{W-OB}(X) = \{1,2,4,5,6,7\}$ and $BR_{W-OB}(X) = \{1,4,5,7\}$. The corresponding nano topology and its basis are given by $\tau_{W-OB}(X) = \{\emptyset, U, \{2,6\}, \{1,4,5,7\}, \{1,2,4,5,6,7\}\}$ and $\beta_{W-OB}(X) = \{\emptyset, U, \{2,6\}, \{1,4,5,7\}\} = \beta_S(X)$. Hence CORE = {Diabetes, Hypertension}.

Case II. Patients not with Chronic Kidney Disease:

Here the set of patients with CKD is $X = \{3,4,7,8\}$. Then $LB_S(X) = \{3,8\}$, $UB_S(X) = \{1,3,4,5,7,8\}$ and $BR_S(X) = \{1,4,5,7\}$ .Therefore the nano topology on U is given by $\tau_S(X) = \{\emptyset, U, \{3,8\}, \{1,4,5,7\}, \{1,3,4,5,7,8\}\}$ and the basis is given by $\beta_S(X) = \{\emptyset, U, \{3,8\}, \{1,4,5,7\}\}$. The issue is to find the key factors that cause chronic kidney disease.

When the attribute DB is deleted from S, $U/R(S - DB) = \{1,3,4\}, \{2\}, \{5,7\}, \{6\}, \{8\}\}$ and hence $LB_{S-DB}(X) = \{8\}$, $UB_{S-DB}(X) = \{1,3,4,5,7,8\}$ and $BR_{S-DB}(X) = \{1,3,4,5,7\}$. The corresponding nano topology and its basis are given by $\tau_{S-DB}(X) = \{\emptyset, U, \{8\}, \{1,3,4,5,7\}, \{1,3,4,5,7,8\}\}$ and $\beta_{S-DB}(X) = \{\emptyset, U, \{8\}, \{1,3,4,5,7\}\} \neq \beta_S(X)$.

If the attribute SA is removed from S, $U/R(S - SA) = \{1,4\}, \{2\}, \{3\}, \{5,7\}, \{6\}, \{8\}\}$, then $LB_{S-SA}(X) = \{3,8\}$, $UB_{S-SA}(X) = \{1,3,4,5,7,8\}$ and $BR_{S-SA}(X) = \{1,4,5,7\}$. The corresponding nano topology and its basis are given by $\tau_{S-SA}(X) = \{\emptyset, U, \{3,8\}, \{1,4,5,7\}, \{1,3,4,5,7,8\}\}$ and $\beta_{S-SA}(X) = \{\emptyset, U, \{3,8\}, \{1,4,5,7\}\} = \beta_S(X)$.

When the attribute HT is ignored from S, $U/R(S - HT) = \{1,4,6\}, \{2,8\}, \{3,5,7\}\}$ and hence $LB_{S-HT}(X) = \{\emptyset\}$, $UB_{S-HT}(X) = \{U\}$ and $BR_{S-HT}(X) = \{U\}$. The corresponding nano topology and its basis are given by $\tau_{S-HT}(X) = \{\emptyset, U\}$ and $\beta_{S-HT}(X) = \{\emptyset, U\} \neq \beta_S(X)$.

If the attribute OB is removed from S, $U/R(S - OB) = \{1,4\}, \{2\}, \{3\}, \{5,7\}, \{6\}, \{8\}\}$, then

$LB_{S-OB}(X) = \{3,8\}$, $UB_{S-OB}(X) = \{1,3,4,5,7,8\}$ and $BR_{S-OB}(X) = \{1,4,5,7\}$. The corresponding nano topology and its basis are given by $\tau_{S-OB}(X) = \{\emptyset, U, \{3,8\}, \{1,4,5,7\}, \{1,3,4,5,7,8\}\}$ and $\beta_{S-OB}(X) = \{\emptyset, U, \{3,8\}, \{1,4,5,7\}\} = \beta_S(X)$.

If the attribute FH is deleted from S, $U/R(S-FH) = \{1,4\}, \{2\}, \{3\}, \{5,7\}, \{6\}, \{8\}\}$, then

$LB_{S-FH}(X) = \{3,8\}$, $UB_{S-FH}(X) = \{1,3,4,5,7,8\}$ and $BR_{S-FH}(X) = \{1,4,5,7\}$. The corresponding nano topology and its basis are given by $\tau_{S-FH}(X) = \{\emptyset, U, \{3,8\}, \{1,4,5,7\}, \{1,3,4,5,7,8\}\}$ and $\beta_{S-FH}(X) = \{\emptyset, U, \{3,8\}, \{1,4,5,7\}\} = \beta_S(X)$.

Therefore CORE = {Diabetes, Hypertension}.

4. Conclusion

In this paper the concept of elimination of attribute and basis in nano topology has been applied to identify the key factors that cause chronic kidney disease. It was identified that the risk factors that cause CKD are Diabetes and Hypertension. This risk can be prevented by taking healthy food and proper medical care.

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FUZZY WALK AND ITS DISTANCE OF FUZZY GRAPH

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ABSTRACT. The fuzzy adjacency relation of fuzzy graph induces the fuzzy walk on fuzzy graph. A number of concepts arising from the fuzzy adjacency leading to fuzzy walk are enumerated. The relationship between the fuzzy path, walk and trail are established. The construction of a fuzzy path from fuzzy graph is proposed. The equivalent relations for these concepts are given. An algorithm is developed to determine the fusion of vertices in fuzzy graph and is verified through example. Various distance of fuzzy walk is estimated.

1. INTRODUCTION

The primary aim of this paper is to study fuzzy walk, path and trail of fuzzy graph. A fuzzy subset of a nonempty set S is a mapping $\sigma : S \to [0,1]$, see [5, 12, 13].

A fuzzy relation on S is a fuzzy subset of $S \times S$. If μ and ν are fuzzy relations, then $\mu o \nu(u,w) = Sup\{\mu(u,v)\Lambda\nu(v,w) : v \in S\}$ and $\mu^k(u,v) = Sup\{\mu(u,u1) \Lambda\nu(u1,u2)\Lambda\mu(u2,u3)\Lambda \ldots \Lambda\mu(uk-1,v) : u1,u2,\ldots uk-1 \in S\}$, where '$\Lambda$' stands for minimum.

Later on a fuzzy graph is defined as a pair of functions $G : (\sigma,\mu)$ where $\sigma : V \to [0,1]$ is a fuzzy subset of non-empty set V and $\mu : V \times V \to [0,1]$ is symmetric fuzzy relation on σ such that for all x,y in V the condition $\mu(u,v) \leq \sigma(u)\Lambda\sigma(v)$ is satisfied for all (u,v) in E, [9]. Fuzzy adjacent matrices

are probably the most frequently used matrix representation of a fuzzy graph. In many circumstances, it is not necessary to have a direct connection with an edge, but rather a route to be able to go from one vertex to another in some number of steps. If there is any two vertices in a given fuzzy graph which are not adjacent to each other, they might be adjacent to a common neighbor, or more generally they might be connected by a sequence of edges with membership values. This idea captured the existence of fuzzy adjacent matrix, [6,8,11].

Definition 1.1. *[2] The fuzzy adjacent matrix of fuzzy graph is defined as*

$$A_{FG}\left(U_i, V_j\right) = \begin{cases} \mu(u_i, v_j) \ if \ u_i \ and \ v_j \ are \ adjacent \\ 0 \ otherwise \end{cases}.$$

These concepts provides the basis for defining the fuzzy walk on fuzzy graph.

Definition 1.2. *[3] For two (not necessarily distinct) vertices u and v in a fuzzy graph FG, a $u - v$ fuzzy walk in FG is a sequence of vertices in FG, beginning with u and ending at v such that consecutive vertices in W are adjacent in FG with $\mu\left(u_i, \ v_j\right) \geq 0$ such a fuzzy walk in a fuzzy graph can be expressed as:*

$$W = u_0\mu\left(u_0, \ v_1\right), v_1\mu\left(v_1, \ v_2\right), v_2\mu\left(v_2, \ v_3\right), \ldots, v_{n-1}\mu\left(v_{n-1}, v_n\right), v_n$$

where $v_i v_{i+1} \in FG \in for 0 \leq i \leq n - 1$.

The fuzzy walk W is said to contain each vertex $v_i(0 \leq i \leq n)$ with $\mu\left(v_i, \ v_{i+1}\right) \geq 0$ and each edge $v_i v_{i+1}(0 \leq i \leq n - 1)$. As a consequence of fuzzy walk in a fuzzy graph, fuzzy path and its trail is also refined.

Definition 1.3. *A fuzzy path in a fuzzy graph is a sequence of distinct nodes $v_0, v_1, v_2, \ldots, v_n$ such that for all $\left(v_i, \ v_{i+1}\right), \mu\left(v_i, \ v_{i+1}\right) > 0$.*

A vertex in a fuzzy graph v_i is said to be accessible or reachable from v_j if there is a fuzzy path from v_i to v_j with $\mu\left(v_i, \ v_{i+1}\right) \geq 0$.

Definition 1.4. *A fuzzy walk in a fuzzy graph in which $\mu\left(v_i, \ v_{i+1}\right) \geq 0$ is no repeated is a trail in a fuzzy graph.*

The fusion of vertices under maxmin composition is found using an algorithm. The distance of a fuzzy walk is determined and it induces metric on the vertex set. In this paper the existence of fuzzy walk and its varieties are established.

2. FUZZY WALK AND ITS DISTANCE IN FUZZY GRAPH

Fuzzy walk theory is rapidly moving into the main stream of fuzzy graph theory. Many applications of fuzzy graphs involve 'getting from one vertex to another', see [1, 4, 6, 7, 10].
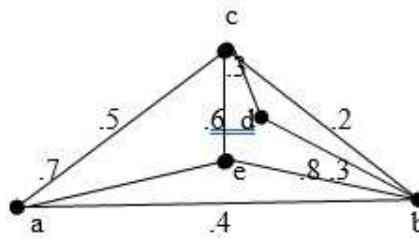
FIGURE 1

On the figure 1 the walk is given by

$$W = \sigma(a)(.5)\,\sigma(c)(.2)\,\sigma(b)(.8)\,\sigma(d)(.3)\,\sigma(c)(.6)\,\sigma(e).$$

Let $\sigma(u_1) = \sigma(u) = \sigma(a)$,
$\sigma(u_2) = \sigma(c), \sigma(u_3) = \sigma(b), \sigma(u_4) = \sigma(d), \sigma(u_5) = \sigma(c), \sigma(u_6) = \sigma(e) = \sigma(v)$.
In this process $\sigma(u_2) = \sigma(u_5)$. Hence delete $\sigma(u_5)$. The deletion of $\sigma(u_5)$ gives
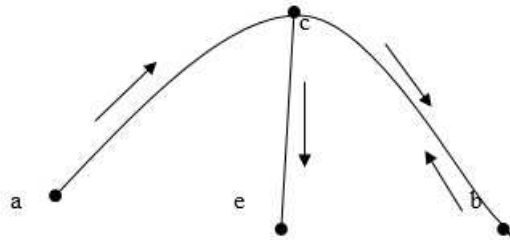
FIGURE 2

the walk on Figure 2,

$$W = \sigma(a)(.5)\,\sigma(c)(.2)\,\sigma(b)(.8)\,\sigma(d)(.3)\,\sigma(e).$$

This is nothing but the path P of the above graph.
The above example leads to the following theorem:

Theorem 2.1. *Let u and v be the vertices of the fuzzy graph $G(\sigma, \mu)$. Every $\sigma(u) - \sigma(v)$ walk in G contains $\sigma(u) - \sigma(v)$ path.*

Proof. Let $W = \sigma(u)\,\mu(e_1)\,\sigma(v_1)\,\mu(e_2),\ldots,\sigma(v_{k-1})\mu(e_k)\sigma(v)$ be the given walk. If $\sigma(u) = \sigma(v)$ then W is closed. Then there will be a trivial path where $P = u$. Suppose $\sigma(u) \neq \sigma(v)$ then W is open.
Let the vertices of W be given in the order as
$\sigma(u) = \sigma(u_0)\,\sigma(u_1)\,\sigma(u_2)\ldots\sigma(u_{k-1})\,\sigma(u_k) = \sigma(v)$.
If no vertices of $F(G)$ occurs more than once then W is a $\sigma(u) - \sigma(v)$ path. Therefore $P = W$.
Suppose that there are vertices in $F(G)$ that occurs in W twice or more then there are distinct j, k with $j < k$ such that $\sigma(u_j) = \sigma(u_k)$.
If $\sigma(u_j), \sigma(u_{j+1}), \ldots, \sigma(u_{k-1})$ are deleted from W then $\sigma(u) - \sigma(v)$ walk W_1 is obtained having fewer vertices than W.
But if the vertices are not repeated in W_1 then W_1 is a $\sigma(u) - \sigma(v)$ path. Hence $P = W_1$. If this is not the case then the process is repeated by deletion procedure until arriving at the $\sigma(u) - \sigma(v)$ walk which is a path. $\qquad\square$

Theorem 2.2. *If $G(\sigma, \mu)$ is the fuzzy graph with n vertices $\sigma(v_1), \sigma(v_2), \sigma(v_3), \ldots, \sigma(v_n)$ contains a $\sigma(u) - \sigma(v)$ walk of length l then G contains $\sigma(u) - \sigma(v)$ path of atmost length l.*

Proof. The proof is by contradiction.
Among all the $\sigma(u) - \sigma(v)$ walks in G, let $W : \sigma(u) = \sigma(v_0), \sigma(v_1), \sigma(v_2), \ldots, \sigma(v_k) = \sigma(v)$ be a $\sigma(u) - \sigma(v)$ walk of smallest length k. Therefore $k \leq l$.
Claim: W is a $\sigma(u) - \sigma(v)$ path.
Assume on the contrary that this is not the case.
Then some vertex in G must be repeated in W say $\sigma(u_i) = u_j$ for some i and j with $0 \leq i < j \leq k$.
Deletion of the vertices $\sigma(u_{i+1}), \sigma(u_{i+2}), \ldots, \sigma(u_j)$ from W, $\sigma(u) - \sigma(v)$ walk given by $\sigma(u_0), \sigma(u_1), \sigma(u_2), \ldots, \sigma(u_{i-1})\sigma(u_i), \sigma(u_{i+1}), \sigma(u_{i+2}), \ldots, \sigma(u_{j-1}), \sigma(u_j), \sigma(u_{j+1}), \sigma(u_{j+2}), \ldots, \sigma(u_n)$ is arrived whose length is less than k which is impossible.
Therefore W is a $\sigma(u) - \sigma(v)$ path of length $k \leq l$. $\qquad\square$

Theorem 2.3. *If $G(\sigma, \mu)$ is the fuzzy graph with n vertices $\sigma(v_1), \sigma(v_2), \sigma(v_3), \ldots, \sigma(v_n)$ then there is a $\sigma(u) - \sigma(v)$ trail iff there is a $\sigma(u) - \sigma(v)$ path.*

Proof. Since every path is a trail, if there is a $\sigma(u)$ to $\sigma(v)$ path it is automatic that there is a $\sigma(u)$ to $\sigma(v)$ trail. Therefore it suffices to prove that if there is a $\sigma(u)$ to $\sigma(v)$ trail then there is a $\sigma(u)$ to $\sigma(v)$ path.

Assume that there is a $\sigma(u)$ to $\sigma(v)$ trail in G.

Among all the trails choose a trail of minimum length and denote it by

$\sigma(v_0), \sigma(v_1), \sigma(v_2), \ldots, \sigma(v_n)$ where $\sigma(v_0) = u$ and $\sigma(v_n) = v$.

If there is only one $\sigma(u)$ to $\sigma(v)$ trail, it will be the one with minimum length.

If in the trail $\sigma(v_0), \sigma(v_1), \sigma(v_2), \ldots, \sigma(v_n)$, no vertex is repeated then it is a path from $\sigma(u) - \sigma(v)$. This completes the proof.

Otherwise the trail $\sigma(v_0), \sigma(v_1), \sigma(v_2), \ldots, \sigma(v_n)$ will be of the form

$\sigma(v_0), \sigma(v_1), \sigma(v_2), \ldots, \sigma(v_{i-1})\sigma(v_i), \quad \sigma(v_{i+1}), \sigma(v_{i+2}), \ldots, \sigma(v_{j-1}), \sigma(v_j), \sigma(v_{j+1}),$
$\sigma(v_{j+2}), \ldots, \sigma(v_n)$ where $\sigma(v_j) = v_i$ for some v_i and v_j.

Consider the trail

$\sigma(v_0), \sigma(v_1), \sigma(v_2), \ldots, \sigma(v_{i-1})\sigma(v_i), \sigma(v_j), \sigma(v_{j+1}), \sigma(v_{j+2}), \ldots, \sigma(v_n)$ which is got by skipping the vertices $\sigma(v_{i+1}), \sigma(v_{i+2}), \ldots, \sigma(v_{j-1})$ together with all edges preceding them. Evidently the trail is shorter than

$\sigma(v_0), \sigma(v_1), \sigma(v_2), \ldots, \sigma(v_{i-1})\sigma(v_i), \sigma(v_{i+1}), \sigma(v_{i+2}), \ldots, \sigma(v_{j-1}), \sigma(v_j), \sigma(v_{j+1}),$
$\sigma(v_{j+2}), \ldots, \sigma(v_n)$ which is a contradiction.

Hence the trail with minimum length has to be a path. $\qquad\square$

Theorem 2.4. *Let $\sigma(u)$ and $\sigma(v)$ be the vertices of the fuzzy graph $G(\sigma, \mu)$. If $\sigma(u) \neq \sigma(v)$ then the following statements are equivalent:*

(1) *There is a fuzzy walk from $\sigma(u)$ to $\sigma(v)$.*
(2) *There is a fuzzy trail from $\sigma(u)$ to $\sigma(v)$.*
(3) *There is a fuzzy path from $\sigma(u)$ to $\sigma(v)$.*

Furthermore given a fuzzy walk from $\sigma(u)$ to $\sigma(v)$ there is a fuzzy path from $\sigma(u)$ to $\sigma(v)$ all of whose edges are in the fuzzy walk.

Proof. Since every fuzzy path is a trial, (3) $\Rightarrow$ (2).

Since every fuzzy trail is a fuzzy walk, (2) $\Rightarrow$ (1).

Thus it suffices to prove (1) $\Rightarrow$ (2).

Let $\mu(e_1)\,\mu(e_2)\,\mu(e_3),\ldots,\mu(e_k)$ be a fuzzy walk from $\sigma(u)$ to $\sigma(v)$. Let n be the number of repeated vertices in a fuzzy walk.

The induction on 'n' is used.

If the fuzzy walk has no repeated vertices, it is a fuzzy path. This starts the induction on $n = 0$.

Suppose $n > 0$.

Let $\sigma(r)$ be the repeated vertex. Suppose it first appears in edge $\mu(e_i)$ and last appears on $\mu(e_j)$.

If $\sigma(r) = \sigma(u)$ then $\mu(e_j)\mu(e_{j+1})\mu(e_{j+2}),\ldots,\mu(e_k)$ is the fuzzy walk from $\sigma(u)$ to $\sigma(v)$ in which $\sigma(r)$ is not a repeated vertex.

Again if $\sigma(r) = \sigma(v)$ then $\mu(e_1)\mu(e_2)\mu(e_3),\ldots,\mu(e_i)$ is the fuzzy walk from $\sigma(u)$ to $\sigma(v)$ in which $\sigma(r)$ is not a repeated vertex.

Otherwise, $\mu(e_1)\mu(e_2)\mu(e_3),\ldots,\mu(e_i)\mu(e_j)\mu(e_{j+1})\mu(e_{j+2}),\ldots,\mu(e_k)$ is a fuzzy walk from $\sigma(u)$ to $\sigma(v)$ in which $\sigma(r)$ is not a repeated vertex.

Hence there are less than n repeated vertices in this fuzzy walk from $\sigma(u)$ to $\sigma(v)$ and so there is a fuzzy path by induction. Since the fuzzy path is constructed by removing edges from the fuzzy walk the last statement of the theorem follows.   □

Theorem 2.5. *Let $\sigma(u)$ and $\sigma(v)$ be the vertices of the fuzzy graph $G(\sigma,\mu)$. Two vertices $\sigma(u) \neq \sigma(v)$ are on a fuzzy cycle of fuzzy graph iff there are at least two fuzzy paths from $\sigma(u)$ to $\sigma(v)$ that have no vertices in common except the endpoint $\sigma(u)$ and $\sigma(v)$.*

Proof. Consider $\sigma(u)$ and $\sigma(v)$ are on the fuzzy cycle.

The fuzzy cycle from $\sigma(u)$ to $\sigma(v)$ is followed to obtain one fuzzy path.

Then the fuzzy cycle is followed from $\sigma(v)$ to $\sigma(u)$ to obtain another.

Since the fuzzy cycle has no repeated vertices, the only vertices that lie on both the fuzzy paths are $\sigma(u)$ and $\sigma(v)$.

On the other hand, a fuzzy path from $\sigma(u)$ to $\sigma(v)$ is followed by a fuzzy path $\sigma(v)$ to $\sigma(u)$ is a fuzzy cycle if the fuzzy paths have no common vertices other than $\sigma(u)$ and $\sigma(v)$.   □

Theorem 2.6. *Let $G(\sigma,\mu)$ be the fuzzy graph with n vertices $v_1, v_2, v_3, \ldots, v_n$ and Adj_{FG} be the fuzzy adjacent matrix of G with respect to this listing of this vertices. Let k be any positive integer and $Adj_{FG}{}^k$ denote the max-min composition of k copies of Adj_{FG}. Then the $(i,j)^{th}$ entry of $Adj_{FG}{}^k$ is the $v_i - v_j$ walk with distinct $\mu(v_i, v_j)$ in G.*

Proof. The proof is by mathematical induction on k.

For $k = 1$, the $(i,j)^{th}$ entry of Adj_{FG} is the $v_i - v_j$ walk with distinct $\mu(v_i, v_j)$ in G.

Assume that the result is true for $Adj_{FG}{}^{k-1}$ where $k > 1$ and prove the result for $Adj_{FG}{}^{k}$.

Let $Adj_{FG}{}^{k-1} = b_{ij}$ where b_{ij} is the $v_i - v_j$ walk with distinct $\mu(v_i, v_j)$ in G.

If $Adj_{FG}{}^{k} = c_{ij}$ where c_{ij} is the $v_i - v_j$ walk with distinct $\mu(v_i, v_j)$ in G,

Then $Adj_{FG}{}^{k} = Adj_{FG}{}^{k-1} \circ AdjFG$

$= \sum_{t=1}^{n}[(i, t)^{th}$ element of $Adj_{FG}{}^{k-1}] \circ [t, jth$ element of $AdjFG] = \sum_{t=1}^{n}[b_{it} \circ atj]$

Now every $v_i - v_j$ walk consists of $v_i - v_t$ walk with distinct $\mu(v_i, v_j)$ where v_t is adjacent to v_j followed by an edge $v_t v_j$.

Since there are b_{it} and a_{tj} such walks for each vertex v_t.

Therefore the total number of all $v_i - v_j$ walk is $\sum_{t=1}^{n}[b_{it} \circ atj]$ which is nothing but $Adj_{FG}{}^{k}$. $\qquad\square$

Theorem 2.7. *If $G(\sigma, \mu)$ is the fuzzy graph without any fuzzy cycles then $G(\sigma, \mu)$ has atleast one pendant vertex.*

Proof. Consider a fuzzy path in G which has a maximum number of vertices. Let $\sigma(u)$ be the end vertex of P. This implies every neighbour of $\sigma(u)$ belongs to P. Suppose a neighbour x of $\sigma(u)$ does not belong to P then a path $P1$ is obtained by extending P to x, then P will be longer a path with maximum number of vertices. Hence every neighbour of $\sigma(u)$ belongs to P.

If u has atleast two neighbours, say y and z, then y and z both belong to P and then the edges $(u, y), (y, z), (z, u)$ form a cycle. This is impossible as G has no cycles. Hence u can have only one neighbour. Accordingly u is a pendant vertex. Thus G has atleast one pendant vertex. $\qquad\square$

Theorem 2.8. *Let $G(\sigma, \mu)$ be the fuzzy graph with n vertices $v_1, v_2, v_3, \ldots, v_k$ and $P = v_1 v_2 v_3, \ldots, v_k$ be the fuzzy path in G and u be any vertex in $V - V(P)$. If there is no $v_1 - v_k$ fuzzy path with vertex set $V(P) \cup \{u\}$ then $|\{u, V(P)\}| \leq k + 1$ when $\{u, V(P)\}$ is the set of all arcs in P with one end in u or $V(P)$ and the other end in $V(P)$ or u respectively.*

Proof. By the assumption on P, for any $u \in V - V(P)$ there is no $u_i \, uu_{i+1}$ in P.

Therefore for each $i, 1 \leq i \leq k - 1, |\{u_i, u\}| + |\{u, u_{i+1}\}| \leq 1$

Thus $|\{u, V(P)\}| = \sum_{i=1}^{k-1}[|\{u_i, u\}| + |\{u, u_{i+1}\}| + |\{u, u_1\}| + |\{u_k \, u\}|]$

$\leq (k - 1) 1 + 2 |\{u, V(P)\}| \leq k + 1.$ $\qquad\square$

3. FUSION OF VERTICES IN FUZZY GRAPH

In this section is given an algorithm for obtaining the adjacency matrix of the fuzzy graph.

ALGORITHM

Step 1: Change $u's$ row to the $max(u, v)$ row and symmetrically change $u's$ column to the $max(u, v)$ column.

Step 2: Delete the row and column corresponding to v if u is maximized or u if v is maximized. The resulting matrix is the adjacency matrix of new graph G_1.

Fuzzy Graph G   Fuzzy graph G₁
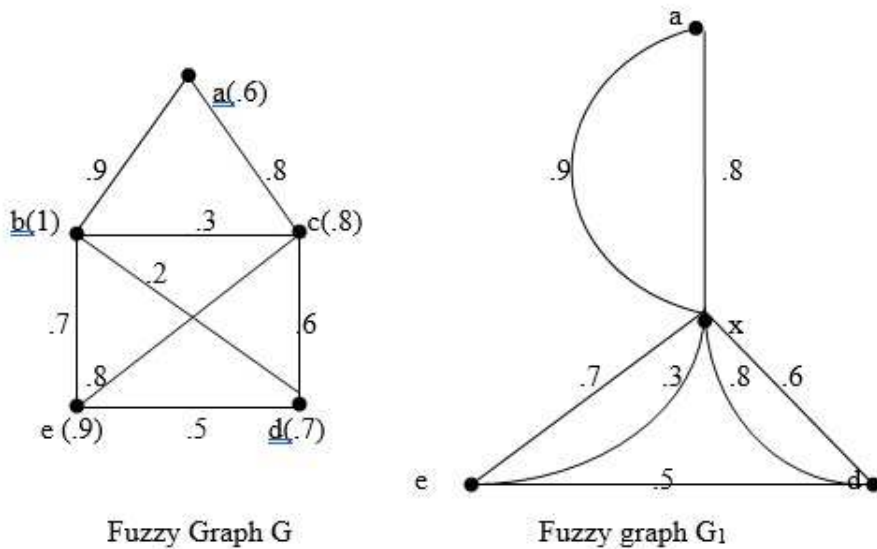
The fuzzy adjacency matrix of the above fuzzy graph is:

$$
\text{Adj}_{FG} = \begin{bmatrix} 0 & .9 & .8 & 0 & 0 \\ .9 & 0 & .3 & .7 & .8 \\ .8 & .3 & 0 & .2 & .6 \\ 0 & .7 & .2 & 0 & .5 \\ 0 & .8 & .6 & .5 & 0 \end{bmatrix}.
$$

Step 1: Changing $b's$ row to the $max(b, c)$ row and symmetrically change $b's$ column to the $max(b, c)$ column the resulting matrix is:

$$\text{Adj}_{FG} = \begin{bmatrix} 0 & .9 & .8 & 0 & 0 \\ .9 & .3 & .3 & .7 & .8 \\ .8 & .3 & 0 & .2 & .6 \\ 0 & .7 & .2 & 0 & .5 \\ 0 & .8 & .6 & .5 & 0 \end{bmatrix}.$$

Step 2: Deleting the row and column corresponding to c as b is maximized the resulting matrix is:

$$\text{Adj}_{FG1} = \begin{bmatrix} 0 & .9 & 0 & 0 \\ .9 & .3 & .7 & .8 \\ 0 & .7 & 0 & .5 \\ 0 & .8 & .5 & 0 \end{bmatrix}.$$

The resulting matrix is the adjacency matrix of new graph G_1.

4. DISTANCE OF WALK IN FUZZY GRAPH

Example 1. *The walk is given by* $W = \sigma\,(a)\,(.8)\,\sigma\,(c)\,(.6)\,\sigma\,(e)\,(.5)\,\sigma\,(d)\,(.7)\,\sigma\,(b)$
The following are the distances obtained for the walk in fuzzy graph

- *The Chebyschev distance of two vertices in a walk W is* $d(x,y) = max|x_i - y_i|$ *Example:* $d(a, b) = max\{|.8 - .6|, |.6 - .5|, |.7 - .5|\}$ $= max\{.2, .2, .2\}$
  $d(a, b) = .2$

- *Euclidean distance:* $d(x, y) = \sqrt{\sum_{i=1}^{n} (x_i - y_i)^2}$
  Example: $d(a, b) = \sqrt{(.8 - .6)^2 + (.5 - .6)^2 + (.5 - .7)^2}$
  $= \sqrt{.09}$
  $d(a, b) = 0.3$

- *Squared Euclidean distance:* $d(x, y) = \sum_{i=1}^{n} (x_i - y_i)^2$
  Example: $d(a, b) = (.8 - .6)^2 + (.5 - .6)^2 + (.5 - .7)^2$
  $d(a, b) = 0.09$

- *Manhattan distance:* $d(x,y) = \sum |x_i - y_j|$
  Example: $d(a,b) = \sum [|.8 - .6| + |.5 - .6| + |.5 - .7|]$
  $= .2 + .1 + .2$
  $d(a,b) = .5$

- *Canberra distance:* $d(x,y) = \sum \frac{|x_i - y_j|}{|x_i + y_j|}$
  Example: $d(a,b) = \frac{|.8-.6|}{|.8+.6|} + \frac{|.5-.6|}{|.5+.6|} + \frac{|.5-.7|}{|.5+.7|}$ $d(a,b) = 0.634199134$
- *Bray Curtis distance:* $d(x,y) = \frac{\sum |x_i - y_j|}{\sum |x_i + y_j|}$
  Example: $d(a,b) = \frac{|.8-.6|+|.5-.6|+|.5-.7|}{|.8+.6|+|.5+.6|+|.5+.7|}$
  $d(a,b) = 0.135135135$

Theorem 4.1. *In a fuzzy graph $G : (\sigma, \mu)$, $d : V \times V \to [0,1]$ is a metric on V i.e*
$\forall u, v, w \in V$

(1) $d(u,v) \geq 0 u, v \in V$
(2) $d(u,v) = 0$ *iff* $u = v$.
(3) $d(u,v) = d(v,u)$
(4) $d(u,v) \leq d(u,w) + d(w,v)$.

Proof. (1) and (2) follows from definition. Next a path from u to v is a strong path from v to u. Let P_{1FG} be the $u - w$ path and P_{2FG} be the $w - v$ path whose length is atmost $d(u,w) \cup d(w, v)$. Therefore $d(u,v) \leq d(u,w) + d(w,v)$. $\square$

5. CONCLUSION

The key property of random walk on fuzzy graph is its degree which represents the number of links it has to other nodes. The degree distribution provides the probability of randomly selected nodes in a network. This enables to determine many network phenomenon from network robustness to the spread of viruses. In mobile call networks the values in the interval $[0,1]$ represents the total number of minutes the individual talk with each others on the phone, on the power grid it is the amount of current flowing through a transmission line. Fuzzy walk themselves used to infer the structural properties of networks. It has a wide application in the design and analysis of online random algorithm, resistance, continuous scheduling etc. It has the remarkable application in queuing,

networks, traversal sequences, interacting practical systems and physical systems etc.

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Classification of States of Random Walk on Fuzzy Graphs

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Abstract— In this study the random walk on fuzzy graph is defined precisely through transition probability matrix. The communication relation between vertices are given. In nearly every concept of random walk on fuzzy graph, the primary concern is on the classification of states. The recurrence relation between the states are discussed.

Keywords—random walk, classification of states, recurrence, stochastic process

Introduction

Medhi.J[10] in 2015 interpreted that a stochastic process is simply a probabilistic process. In the simplest possible case a stochastic process amounts to a sequence of random variables known as time series (Eg:MarkovChain).Among the class of stochastic processes, Markov chains are highly utilized for many dynamic phenomena because of demonstration of equilibrium behavior. Efficient computation of equilibrium / transient probability distribution of a Discrete time Markov Chain(DTMC)/Continuous Time Markov Chain(CTMC)is an ever-green research problem.

Markov chain was introduced in 1906 by Andrei Andreyevich Markov. A finite state Markov chain is described by a matrix. If the chain has M states then it is a M x M matrix. The entire set of states in a given Markov chain is partitioned into one or more disjoint classes. A state in finite state Markov chain is recurrent if there is no possibility of going to another state where there can be no return. A state i is transient if there is some j that is accessible from i but from which there is no possible return. Each time when the system returns to i, there is a possibility of going to j eventually this possibility will occur and there can be no further returns to i. For a finite state Markov chain, either all states in a class are transient or all are recurrent. Also the recurrent classes with countably infinite spaces are further classified into either positive recurrent or null recurrent, a distinction does not appear in the finite-state case. For any Markov chain all states in the same class have the same period. For each transient state there

must be walk to some recurrent state. In 2005, Natarajan A.M and Tamilarasi.A[12] gave the concept that in many finite Markov chain with recurrent and transient states.One important quantity of interest is the expected number of visits the process makes to another transient state before it eventually enters anyone of the recurrent states, given that initially the process started in a transient state.

     The probability of going from one state to another state is independent of the previous state. An initial probability distribution combined with the transition probabilities defines the probability for all events in the Markov chain[7]. The matrix of transition probabilities of a Markov chain is called a stochastic matrix .A stochastic matrix is a square matrix of non negative terms in which the elements of each row sum is1.If v_i is the rate at which the process leaves the state i and P_{ij} is the probability that it goes to j , then q_{ij} is the rate when in state i, that the process makes a transition into state j and is known as the transition rate from i to j.

In 2013, Sheldon M.Ross[11] discussed the convergence criterion of Markov chain to equilibrium position which has a wide range of applications in Mathematics .The study of Markov chain has arisen in a wide variety of areas ranging from Genetics and Statistics to Computing and Sociology. Markov chains can be used to model an enormous variety of physical phenomena and can be used to approximate many other kinds of stochastic process. In many real life situations, observations are made over a period of time and they are often influenced by random effects, not just at a single instant but throughout the entire interval of time or sequence of times. Stochastic processes are processes that proceed randomly in time. Stochastic modeling is an interesting and challenging area of Probability and Statistics.

I.RANDOM WALK ON FUZZY GRAPH

Definition

A state j is accessible from i if there is a walk in a fuzzy graph from i to j with $\mu(u_i, v_j)$ and is denoted by i → j.

Definition

Two distinct states i and j communicate if i is accessible from j and j is accessible from i with $\mu(u_i, v_j)$ and is denoted by i ↔ j.

Definition

Let G:(σ, μ) be the fuzzy graph. A recurrent state is a state i that is accessible from all states from i in the vertex with $\mu(u_i, v_j)$.

Definition

A state j is fuzzy recurrent if $\cup\, P_{jj}^{(m)} = \infty$ or $\cap\, P_{jj}^{(m)} = \infty$.

Definition

A subset $R_1 \subset R$ of states is closed if $P_{ij} = 0$ for each i ϵR_1 and j $\notin R_1$.
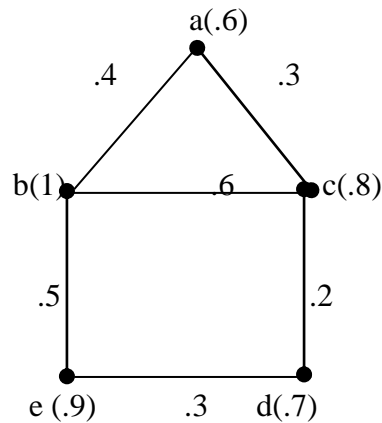
Fig 1:Fuzzy graph

The fuzzy adjacency matrix of the above fuzzy graph is

$$\text{Adj}_{FG} = \begin{bmatrix} 0 & .4 & .3 & 0 & 0 \\ .4 & 0 & .6 & .5 & 0 \\ .3 & .6 & 0 & 0 & .2 \\ 0 & .5 & 0 & 0 & .3 \\ 0 & 0 & .2 & .3 & 0 \end{bmatrix}$$

The transition probability matrix of fuzzy graph is

$$T_{FG} = \begin{bmatrix} 0 & \dfrac{.4}{.7} & \dfrac{.3}{.7} & 0 & 0 \\[2mm] \dfrac{.4}{1.5} & 0 & \dfrac{.6}{1.5} & \dfrac{.5}{1.5} & 0 \\[2mm] \dfrac{.3}{1.1} & \dfrac{.6}{1.1} & 0 & 0 & \dfrac{.2}{1.1} \\[2mm] 0 & \dfrac{.5}{.8} & \dfrac{.2}{.5} & \dfrac{.3}{.5} & \dfrac{.3}{.8} \\[2mm] 0 & 0 & & & 0 \end{bmatrix}$$

The random walk on fuzzy graph is given by $R_{FG} = \dfrac{\mu(u_i,v_j)}{d(\sigma(u_i))}$

II.n- STEP RANDOM WALK

Theorem

i $\rightarrow$ j iff $P_{ij}^{(n)} = P\{X_n = j \mid X_0 = i\,\}$ with $\mu(u_i, v_j) \geq 0$ for n ≥ 1.

Proof

Suppose that a walk $i_0 i_1 i_2 \dots i_n$ exists from node i_0 to node i_n with $\mu(u_0, u_n) \geq 0$

Then conditional on $X_0 = i_0$ is a positive probability $P_{i_0 i_1}$ that $X_1 = i_1$ with $\mu(u_0, u_1) \geq 0$ and consequently there is positive probability that $X_2 = i_2$ with $\mu(u_1, u_2) \geq 0$.

Continuing this argument there is a positive probability that $X_n = i_n$ so that

$P\{X_n = i_n \mid X_0 = i\} \geq 0$.

Also if $P\{X_n = i_n \mid X_0 = i\} \geq 0$ then there is an n-step walk $i_0 i_1 i_2 \ldots i_n$ with $\mu(u_i, v_j) \geq 0$.

Theorem

Let G:(σ, μ) be the fuzzy graph. For $n \geq 1$, $P_{ij}^{(n)} \geq 0$ iff G has n step random walk from i to j with $\mu(u_i, v_j) \geq 0$ perhaps visiting the same node more than once.

Proof

Let $P_{ij}^{(n)} = P\{X_n = j \mid X_0 = i\}$ with $\mu(u_i, v_j) \geq 0$

The proof is by mathematical induction on n.

Let $P_{ij}^{(1)} = P\{X_1 = j \mid X_0 = i\}$ with $\mu(u_i, v_j) \geq 0$

Now under max-min composition

$P_{ij}^{(1)} = P_{ij}^{(1)} \circ P_{ij}^{(0)}$

$\qquad = P\{X_1 = j \mid X_0 = i\} \circ P\{X_0 = i\}$

$\qquad = \mu(u_i, v_j) \geq 0$

Now

$P_{ij}^{(2)} = P_{ij}^{(1)} \circ P_{ij}^{(1)}$

$\qquad = P\{X_1 = j \mid X_0 = i\} \circ P\{X_1 = j \mid X_0 = i\}$

$\qquad = \mu(u_i, v_j) \geq 0$

Assume that the result is true for k = n and prove for k+1.

For k = n , $P_{ij}^{(k)} = P\{X_k = j \mid X_0 = i\}$ with $\mu(u_i, v_j) \geq 0$

Therefore $P_{ij}^{(k+1)} = P_{ij}^{(k)} \circ P_{ij}^{(1)}$

$\qquad\qquad\qquad = P\{X_k = j \mid X_0 = i\} \circ P\{X_1 = j \mid X_0 = i\}$

$\qquad\qquad\qquad = \mu(u_i, v_j) \geq 0$

Hence if $P_{ij}^{(n)} \geq 0$ for $n \geq 1$ there is an n- step walk from state i to j with $\mu(u_i, v_j) \geq 0$

On the other hand if there is an n- step walk from state i to j with $\mu(u_i, v_j) \geq 0$ and m- step walk from j to k with $\mu(u_j, v_k) \geq 0$ the there is a walk of m + n steps from i to k with $\mu(u_i, v_k) \geq 0$

Thus $P_{ij}^{(m+n)} \geq 0$

This gives $P_{ij}^{(n)} \geq 0$ and $P_{ij}^{(m)} \geq 0$ for n ≥ 1 and m ≥ 1.

Theorem

If i ↔ j and m ↔ j then i ↔ m .

Proof

If i ↔ j then i → j and j → i

Now m ↔ j gives m → j and j → m

⇒ i → j and j → m

⇒ i ↔ m

Theorem

The communication relation is an equivalence relation in the states of fuzzy graph.

Proof

I.   i ↔ i ⟹ there exists an n ≥ 0 such that $P_{ii}^{(n)} = \mu(u_i, v_i) \geq 0$

<div align="center">Hence reflexive</div>

II. i ↔ j ⟹ there exists an n ≥ 0 such that $P_{ij}^{(n)} = \mu(u_i, v_j) \geq 0$

j ↔ i ⟹ there exists an n ≥ 0 such that $P_{ji}^{(n)} = \mu(v_j, u_i) \geq 0$

Since the fuzzy graph is undirected $P_{ij}^{(n)} = P_{ji}^{(n)}$.

Therefore i ↔ j ⟹ j ↔ i

<div align="center">Hence symmetric</div>

III.   i ↔ j ⟹ there exists an n ≥ 0 such that $P_{ij}^{(n)} = \mu(u_i, v_j) \geq 0$

j ↔ k ⟹ there exists an m ≥ 0 such that $P_{jk}^{(m)} = \mu(u_j, v_k) \geq 0$

∴ One can get from i to j in m ∪ n and m ∩ n steps by going first to j in n steps and then from j to k in m steps .

$$\sum(P_{ik}^{m \cup n} + P_{ik}^{m \cap n}) \geq P_{ij}^{(n)} P_{jk}^{(m)} \geq 0$$

     Hence transitive

Therefore communication is an equivalence relation in fuzzy graph.

Thus the states are divided into classes through accessibility relation.

All the states communicate to each other within each class .But there is no possibility for a pair of states belonging to different classes to communicate.

If there is only one class then the chain is irreducible. Suppose there are states in a chain then irreducibility means that all the entries of $(I \cup P \cup P^2 \cup P^3 \ldots \cup P^m)$ are non zero.

III.CLASSIFICATION OF STATES

A state j is accessible from state i , i → j if $P_{ij}^{(n)} \geq 0$ for n ≥ 1.This means that there is a possibility of reaching jfrom i in some number of steps.If j is not accessible from i then $P_{ij}^{(n)} = 0$ for all n ≥ 1.Thus the chain started from i never visits j.

$$P(\text{ever visiting j} \mid X_o = i) = P(\cup_{n=1}^{\infty} \sum X_n = j | X_o = i) + P(\cap_{n=1}^{\infty} \sum X_n = j | X_o = i)$$
$$\leq P\{X_n = j \mid X_0 = i\}$$

P(ever visiting j | $X_o = i$) = 0.

If j is accessible from i then $P_{ij}^{(n)} = \mu(u_i, v_j) \geq 0$

If the chain has m states then j is accessible from i iff $(P \cup P^2 \cup P^3 \ldots \cup P^m)_{ij}$ +(P ∩ P^2 ∩ $P^3 \ldots \cap P^m)_{ij} = \mu(u_i, v_j) \geq 0$.

Now let us compute the expected number of visits to j at all times including zero when the chain is at j.

At every visit to j the probability of never visiting j again is 1 - S_j.

Hence P(exactly m visits to j | $X_0 = j$) = $S_j^{m-1} \circ (1 - S_j)$

∴ Maximum number of visits to j is $\cup [S_j \mid X_0 = j]$ and Minimum number of visits to j is ∩ $[S_j \mid X_0 = j]$

Hence $\sum_{n=0}^{\infty} P\{X_m = j \mid X_0 = j\} = \sum_{n=0}^{\infty} P_{jj}^{(n)}$.

To determine classes, a fuzzy graph is drawn with nonzero transition probabilities.
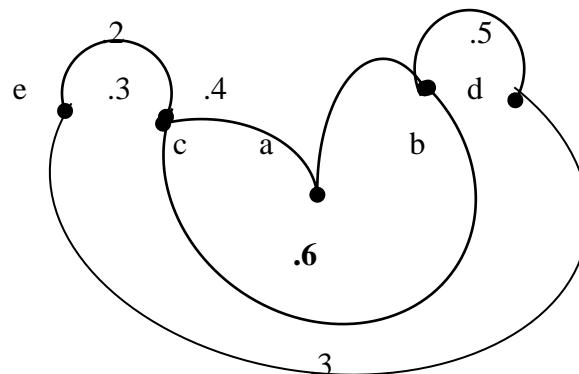
Fig 2:Classification of States

The above fuzzy graph is divided into classes as follows:

P(a) = P(a,b)° P(a,c) = (.4) ° (.3)

P(b) = P(b,a)° P(b,c) = (.4) ° (.6)

P(c) = P(c,b)° P(c,e) = (.6) ° (.2)

P(d) = P(d,b)° P(d,e) = (.5) ° (.3)

P(e) = P(e,c)° P(e,d) = (.2) ° (.3)

Under Max-min composition ,

Probability of moving from state a is 0.4

Probability of moving from state b is 0.6

Probability of moving from state c is 0.6

Probability of moving from state d is 0.3

Probability of moving from state e is 0.3

The Max-min value is 0.3

Under Min-max composition ,

Probability of moving from state a is 0.3

Probability of moving from state b is 0.4

Probability of moving from state c is 0.2

Probability of moving from state d is 0.3

Probability of moving from state e is 0.2

The Min max value is 0.4

Probability of moving away from the given state is prescribed as follows:

Under Max-min composition ,

$P(a^c) = 1 - P(a) = 1\text{-}0.4 = 0.6$

$P(b^c) = 1 - P(b) = 1\text{-} 0.6 = 0.4$

$P(c^c) = 1 - P(c) = 1\text{-} 0.6 = 0.4$

$P(d^c) = 1 - P(d) = 1\text{-} 0.3 = 0.7$

$P(e^c) = 1 - P(e) = 1\text{-} 0.3 = 0.7$

The Max-min value is 0.4

Under Min-max composition ,

$P(a^c) = 1 - P(a) = 1\text{-}0.3 = 0.7$

$P(b^c) = 1 - P(b) = 1- 0.6 = 0.4$

$P(c^c) = 1 - P(c) = 1- 0.2 = 0.8$

$P(d^c) = 1 - P(d) = 1- 0.3 = 0.7$

$P(e^c) = 1 - P(e) = 1- 0.2 = 0.8$

The Min-max value is 0.8

Note

The max-min and min-max value of states and its complement are not equal.

Theorem

All states in a class are either transient or recurrent for a random walk in a fuzzy graph.

Proof

Assume that state i is transient.

That is for some j, $i \rightarrow j$ but $j \nrightarrow i$

Suppose that i and m are in the same class (ie) $i \leftrightarrow m$ with $\mu(u_j, v_m) \geq 0$.

Then $m \rightarrow i$ and $i \rightarrow j$ gives $m \rightarrow j$

Now if $j \rightarrow m$ then the walk in G could be extended to i which is a contradiction.

Therefore there is no walk from j to m and m is transient.

Since all nodes in a class are transient it follows that states in a class are recurrent or all transient.

Theorem

Let $G:(\sigma, \mu)$ be the fuzzy graph. All states in the same class have the same period.

Proof

Let u and v be distinct pair of states in a class C.

Then $u \leftrightarrow v$ and there is some N such that $P_{uv}^{(N)} > 0$ ans some M such that $P_{uv}^{(M)} > 0$.

Since there is a walk of length $N \cup M$ and $N \cap M$ going from u to v and back to u , $N \cup M$ and $N \cap M$ must be divisible by d(u) and d(v).

Let k be any integer such that $P_{vv}^{(k)} > 0$.

Since there is a walk of length $N \cup M \cup K$ and $N \cap M \cap K$ from u to v then back to v and then to u.

$N \cup M \cup K$ and $N \cap M \cap K$ is divisible by d(u) and d(v).

Thus k is divisible by d(u) and d(v).

Since this is true for every k such that $P_{vv}^{(k)} > 0$ and d(u) is divisible by d(v), reversing the roles of u and v, d(u) is divisible by d(v).

Hence d(u) = d(v)

Theorem

For any finite Markov chain there is atleast one recurrent state.

Proof

Let R_0 be the starting state.

Hence the chain stays into R_0 for ever.

Assume on the contrary that all states in R_0 are transient.

This implies that each of them is visited finitely many times with $\mu(u_i, v_j)$ and assumes $max\{\mu(u_i, v_j)\}$ if the visit is maximum, , min$\{ \mu(u_i, v_j)\}$ if the visit is minimum.

This is impossible

Therefore there must be atleast one recurrent state.

Theorem

If k is recurrent and j → k then k → j is recurrent.

Proof

Starting from k the chain reaches from j in m_0 steps provided $P_{jk}^{(m_0)} > 0$

This gives $\mu(u_i, v_j) > 0$

Hence at every time there is a fixed positive probability that it will be at j∪ m_0 or j∩ m_0 steps later.

Starting from k the chain returns to k infinitely many times in [0 , 1].

Every time there is a chance to reach j∪ m_0 or j∩ m_0 steps later with $\mu(u_i, v_j) \geq 0$

Hence the chain reaches j with $\mu(u_i, v_j) \geq 0$

Assume that j → k is not true .

Once the chain reaches j, it never returns to k.

Therefore k is not recurrent which is a contradiction.

Theorem

Any fuzzy recurrent class must be a closed subsets of states.

Proof

Let R_0 be the fuzzy recurrent class .

Hence j ϵ R_0 and k$\notin$ R_0.

Assume that $P_{ij}^n > 0$

This implies that $\mu(u_i, v_j) > 0$

Since j does not communicate with k the chain never reaches k from j.

$\Rightarrow \mu(u_i, v_j) > 0$

This is a contradiction.

IV.CONCLUSION

It is observed that the transition probability matrix of random walk on crisp graph is the fuzzy matrix and the max-min composition of transition probability matrix is regular. A random walk on fuzzy graph is irreducible under max-min composition. It is identified that transition probability matrix of fuzzy graph and the fuzzy adjacent matrix of stochastic graph are same. It was identified that the degree of each vertex in a transition fuzzy graph is one. In addition to this it was found that the sum of the degree of vertices in a transition fuzzy graph equals the sum of its membership values.

V.Applications

Random walk themselves used to infer the structural properties of networks. The length of the random walk starting at vertex i tends to infinity and the probability of being on the vertex j depends on the degree of vertex j. The idea of random walk is used for clustering geometric data and graph diffusion. Fuzzy Graph diffusion refers to the problem involving the spreading of the membership values of a fuzzy graph. The clustering problem is to organize the vertices of a fuzzy graphs into groups where each group is made up of vertices in [0,1] that are close to each other but comparatively separate from the rest of the fuzzy graph. The applications of fuzzy graph clustering are far reaching including problems such as image segmentation, exploratory data analysis and physical network analysis.

The random walk on fuzzy graph has broad applications in web information mining, junk mails filtering, personal news recommendation system, generate random samples from a large set (for instance a set of nodes from a complex networks), index free data space etc.,

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On $\alpha\omega I$ - Closed Sets in Ideal Topological Spaces

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Abstract: **In this paper, we introduce a new class of sets named as $\alpha\omega I$ - closed sets in ideal topological spaces and some of their properties. Further we defined and study the concept of $\alpha\omega I$ - countinuity function in ideal topological spaces and some of their properties.**

Keywords: ω-closed sets, $\alpha\omega I$ closed sets, $\alpha\omega I$ countinuous function.

1 Introduction

In [5,9] the theory of ideal topological spaces was introduced by Kuratowski and Vaidyanathswamy. Ideals in topological space have been considered since 1930. In the year 1990, D.Jankovic and T.R.Hamlett [4] obtained new topologies using old ones and introduced the notion of ideal topological spaces. In the year 1992, Jankovic and Hamlett established the theory of I-open sets in ideal topological spaces. In that initialized the application of topological ideals in the generalization of most fundamental properties in general topology.

In the year 1999, Dontchev proved that a mapping f: $(X,\tau) \rightarrow (Y, \sigma)$ is continuous if and only if it is pre-I-continuous, which is an idealized version of genster-reilly decomposition theorem. An ideal I is an nonempty collection of subsets of X closed with respect to finite union. (X, τ, I) is an ideal topological space(ITS) and it is called as an ideal space. For a subset A of X, the local function of A is defined as: $A^* = \{x \in X : U \cap A$ does not belongs to I for every $U \in \tau(x)\}$, where $\tau(x)$ is the collection of all nonempty open sets containing x. From this simply write A^* instead of $A^*(I)$ to avoid any chance of confusion. A Kuratowski closure operator $cl^*(.)$ for a topology $\tau^*(I,\tau)$ termed as * - topology, finer than τ is determine $cl^*(A) = A \cup A^*$. If $A \subseteq X$, cl(A) and int(A) will denote the closure and interior of A in (X, τ) respectively and $cl^*(A)$ and $int^*(A)$ will denote the closure and interior of A in $(X, *\tau)$ respectively.

In 2013 C.Carpintero, E.Rosas, M.Salas, J.Sanabria and L.Vasquez [1] introduced the concept of Generalization of ω-closed sets via operators and ideals. In 2014 S.Maragathavalli

and D.Vinodhini [6] introduced the concept of α generalized closed sets in ideal topological spaces.

In 2016, O.Ravi, M. Kamaraj, V.Ba.Vijeyrani [8] presented the concept of g # - closed sets in ideal topological spaces. In 2008 M.Navaneethakrishnan and J. Paulraj Joseph [7] introduced the concept G-closed sets in ideal topological spaces. In 2002 E.Hatir and T.Noiri [3] presented the concept of decomposition of continuity via idealization. In 1996 J.Dontchev [2] On pre-I-open sets and a decomposition of I-continuity. The aim of this paper is to extended the sets in ideal that is $\alpha\omega I$ closed sets in ideal topological spaces and study some basic properties.

2 Preliminaries

Throughout this paper (X, τ) and (Y, σ) represent topological spaces. For a subset A of a space (X, τ), cl(A), int(A) denote the closure of A and the interior of A respectively. We recall the following definitions.

Definition 2.1. Let (X, τ) be a topological space. Let I be an ideal defined on X. Then the space (X, τ, I) is termed as ideal topological space, which satisfies the following two conditions:

1. If $A \in I$ and $B \subseteq A \Rightarrow B \in I$.
2. If $A \in I$ and $B \in I$, then $A \cup B \in I$.

Definition 2.2. A subset A of an Ideal topological space (X, τ, I) is termed as

1. pre-I-closed set if cl*(int(A)) $\subseteq$ A. If A $\subseteq$ (int(cl*(A)) then A is called as pre-I-open set.
2. semi-I-closed set if int(cl*(A)) $\subseteq$ A. If A $\subseteq$ (cl*(int(A)) then A is called as semi-I-open set.
3. α-I-closed set if cl*(int(cl*(A))) $\subseteq$ A. If A $\subseteq$ (int(cl*(int(A))) then A is called as α-I-open set.
4. β-I-closed set if (int(cl*(int(A))) $\subseteq$ A. If A $\subseteq$ (cl*(int(cl*(A))) then A is called as β-I-open set.
5. regular-I-closed set if A = cl*(int(A)). If A = (int(cl*(A)) then A is called as regular-I-open set.

Definition 2.3. A mapping f : $(X, \tau, I) \rightarrow (Y, \sigma)$ is said to be

1. α-I-continuous if for every $Z \in \sigma$, $f^{-1}(Z)$ is an α-I-open set of (X, τ, I).
2. semi-I-continuous if for every $Z \in \sigma$, $f^{-1}(Z)$ is a semi-I-open set of (X, τ, I).

3. pre-I-continuous if for every $Z \in \sigma$, $f^{-1}(Z)$ is a pre-I-open set of (X, τ, I).
4. β-I-continuous if for every $Z \in \sigma$, $f^{-1}(Z)$ is a β-I-open set of (X, τ, I)

5. semi-I-regular continuous if for every $Z \in \sigma$, f^{-1} (Z) is an semi-I- regular open set of (X, τ, I).

Lemma 2.4. Let (X, τ ,I) be an ideal topological space. Let A, B be subsets of X. Then the following properties are:

1. $A \subseteq B \Rightarrow A^* \subseteq B^*$,
2. $A^* = cl(A^*) = cl(A) = cl^*(A)$,
3. $(A \cup B)^* = A^* \cup B^*$,
4. $(A \cap B)^* \subseteq A^* \cap B^*$,
5. $(A^*)^* \subseteq A^*$.

3 $\alpha\omega I$ - Closed Sets in Ideal Topological Spaces

In this division we present $\alpha\omega I$ - closed set and studied some of their properties.

Definition 3.1. A subset B of a ideal topological space (X, τ, I) is called an $\alpha\omega I$-closed set if $B^* \subseteq D$ whenever B is a subset of D (B $\subseteq$ D) and D is $\alpha\omega I$ open in the ideal topological space. The complement of an $\alpha\omega I$ - closed set is an $\alpha\omega I$ -open set in the space.

Example 3.2. Let X = {u, v, w} and I = {φ, {v}}. Take τ = {φ, {v}, {v, w}, X} and τ^c = {φ, {u, w}, {w}, X}. Therefore, $\alpha\omega I$ closed sets of X are {φ, {u}, {u, v}, {u, w}, X}.

Theorem 3.3. Every closed set in the ideal topological space (X, τ, I) is an $\alpha\omega I$-closed set.

Proof: Let B be a closed set in the ITS (X, τ, I). Then, B = B*. Let B* $\subseteq$ D, where D is $\alpha\omega$-open in the space (X, τ, I), since B* $\subseteq$ cl(B) $\subseteq$ D. Now, B* $\subseteq$ cl*(B) $\subseteq$ cl(B) $\subseteq$ D. This shows that B is an $\alpha\omega I$-closed in ideal topological spaces. Henceforth every closed set in ideal topological space is an $\alpha\omega I$-closed set. In general the converse of this theorem does not hold.

Example 3.4. Let X = {u, v, w} and I = {φ,{u}}. Take τ = {φ,{u},{v},{u, v},X} and τ^c = {φ ,{v, w} ,{u, w}, {w} ,X}. Therefore, $\alpha\omega I$ closed sets of X are {φ, {w}, {v, w}, {u, w}, X}. Here B = {v, w} is a $\alpha\omega I$ closed set but it is not a closed.

Theorem 3.5. Every ω-closed set in the ideal topological space (X, τ, I) is an $\alpha\omega I$-closed set.

Proof: Let B be a ω-closed set in the ideal topological space (X, τ, I). Let D be any $\alpha\omega I$-open set in X such that B* $\subseteq$ D. Since every $\alpha\omega$-open set is semi-open, B* $\subseteq$ cl(B) $\subseteq$ D. Now, B* $\subseteq$ cl*(B) $\subseteq$ cl(B) $\subseteq$ D. This shows that B is an $\alpha\omega I$ -closed in ideal topological space. Henceforth every ω closed set in ideal topological space is an $\alpha\omega I$-closed set. In general the converse of this theorem does not hold.

Example 3.6. Let X = {u, v, w} and I = {φ, {v}}. Take τ = {φ, {v}, {v, w}, X} and τ ^{c} = {φ, {u, w} ,{u}, X}. Therefore, $\alpha\omega I$ closed sets of X are {φ, {u}, {u, v}, {u, w}, X}. Here B = {u, v} is a $\alpha\omega I$ closed set but it is not a ω-closed set.

Theorem 3.7. Every g $^\#$ - closed set in the ideal topological space (X, τ, I) is an $\alpha\omega I$-closed set.

Proof: Let B be a g $^\#$ - closed set in the ideal topological space (X, τ, I). Let D be any $\alpha\omega$-open set in X such that B* $\subseteq$ D. Since every $\alpha\omega$-open set is g α - open, B* $\subseteq$ cl(B) $\subseteq$ D. Now, B* $\subseteq$ cl*(B) $\subseteq$ cl(B) $\subseteq$ D. This shows that B is an $\alpha\omega I$ - closed in ITS. Henceforth every g $^\#$ closed set in ideal topological space is an $\alpha\omega I$-closed set. In general the converse of this theorem does not hold.

Example 3.8. Let X = {u, v, w} and I = {φ, {v}}. Take τ = {φ, {v}, {u, v}, X} and τ ^{c} = {φ, {u, w}, {w}, X}. Therefore, $\alpha\omega I$ closed sets of X are {φ, {w}, {v, w}, {u, w}, X}. Here B = {v, w} is a $\alpha\omega I$ closed set but it is not a g $^\#$ - closed set.

Theorem 3.9. Union of two $\alpha\omega I$-closed sets are $\alpha\omega I$-closed set in any ideal topological space (X, τ, I).

Proof: Let M and N be two $\alpha\omega I$-closed sets in the ideal topological space. Let D be any $\alpha\omega$-open set in the space such that M ∪ N $\subseteq$ D. Then, M $\subseteq$ D and N $\subseteq$ D, M and N are $\alpha\omega I$-closed sets. Since M* $\subseteq$ D and N* $\subseteq$ D whenever M* ∪ N* $\subseteq$ (M ∪ N)* $\subseteq$ D, D is $\alpha\omega$-open. Henceforth M ∪ N is $\alpha\omega I$-closed set in ideal topological space.

Remark 3.10. The intersection of two $\alpha\omega I$ - closed sets need not be $\alpha\omega I$ - closed set.

Theorem 3.11. If a subset B of X is $\alpha\omega I$-closed set in the ideal topological space (X, τ, I), then α B* - B does not contain any empty $\alpha\omega$-closed sets in the space (X, τ, I).

Proof: Given B is an $\alpha\omega I$-closed subset of X. Let E be a non empty $\alpha\omega$-closed subset of B* - B. Then E $\subseteq$ B* ∩ (X-B), since (X-B) is $\alpha\omega$-open and B* is $\alpha\omega I$-closed set. B* $\subseteq$ (X - B) therefore E $\subseteq$ (X - B*). Thus E $\subseteq$ B* ∩ (X - B*) = φ. This implies that E = φ. Then B* - B does not contain any non empty $\alpha\omega I$-closed sets.

Theorem 3.12. If B is $\alpha\omega I$-closed set in the ITS (X, τ, I) and B $\subseteq$ C $\subseteq$ α B* then C is also $\alpha\omega I$-closed set in X.

Proof: Suppose B is $\alpha\omega I$-closed set in X. Let C $\subseteq$ D such that D is $\alpha\omega$-open set in X. Since B $\subseteq$ C, B* $\subseteq$ D. Since B is $\alpha\omega I$ -closed and cl*(C) $\subseteq$ cl*(cl*(B)) = cl*(B) $\subseteq$ D. Therefore, cl*(C) $\subseteq$ D. Henceforth C is $\alpha\omega I$-closed set in X.

Theorem 3.13. Let B be $\alpha\omega I$-closed set in the ideal topological space (X, τ, I). Then B is ω-closed in X iff B* - B = φ is α-closed.

Proof: Suppose B is ω-closed. Then B* = B and so B* - B = φ, which is α-closed. Conversely B* - B is α-closed. Then B* - B = φ, since B is $\alpha\omega I$-closed set in X. Thus B* - B (or) B is ω-closed.

Theorem 3.14. Let B is $\alpha\omega$-open and $\alpha\omega I$-closed set in the ideal topological space $(X, τ, I) then B is ω-closed.

Proof: Since B ⊆ B and B is $\alpha\omega$-open and $\alpha\omega I$-closed, B* ⊆ B. Thus B* = B. Henceforth B is ω-closed set in X.

Theorem 3.15. A set B is $\alpha\omega I$-open in the ideal topological space (X, τ, I) iff E ⊆ int*(B) whenever E is an α-closed in the space and E ⊆ B.

Proof: Suppose E ⊆ int*(B) where E is α-closed set and E ⊆ B. Let X-B ⊆ J where J is $\alpha\omega$-open in the space. Then J ⊆ X-J and X-J ⊆ int*(B). Thus X-A is $\alpha\omega I$-closed set in the space. Henceforth B is $\alpha\omega I$-open in the space. Conversely, suppose that B is $\alpha\omega I$-open in the space. E ⊆ B and B is α-closed in the space. Then X-E is $\alpha\omega I$-open and X-B ⊆ X-E. Therefore, B*(X-B) ⊆ X-E. But B*(X-B) = X-int*(B). Henceforth E ⊆ int*(B).

Theorem 3.16. A subset B is $\alpha\omega I$-open in the ideal topological space (X, τ, I) iff J = X whenever J is $\alpha\omega$-open and int*(B) ∪ (X-J) ⊆ J.

Proof: Let B be $\alpha\omega I$-open in the ideal topological space (X, τ, I). J be $\alpha\omega$-open and int*(B) ∪ (X-B) ⊆ J. This gives X-J ⊆ (X-int*(B)) ∩ (X-(X-B)) = X-int*(B)-(X-B) = cl*(X-B) - (X-B), X-B is $\alpha\omega I$-closed and X-J is α-closed. Then by Theorem 3.15, it follows that X-J = φ. Therefore X = J. Conversely, suppose E is an α-closed and E ⊆ B. Then int*(B) ∪ (X-B) ⊆ B ∪ (X-E). It follows that int*(B) ∪ (X-E) = X and hence E ⊆ int*(B). Therefore, B is an $\alpha\omega I$-open in the space X.

4 On $\alpha\omega I$-Continuity in Ideal Topological Spaces

In this section, we defined $\alpha\omega I$-continuity and studied some of their properties.

Definition 4.1. A function h : (X, τ, I) → (Y, σ) is called an $\alpha\omega I$-continuous if h^{-1} (Z) is $\alpha\omega I$-closed set of the space (X, τ, I) for every closed set Z of (Y, σ).

Theorem 4.2. Every continuous map in the ideal topological space (X, τ, I) is $\alpha\omega I$-continuous.

Proof: Let h be a continuous and let Z be a closed set of (Y, σ). Since h is continuous, then h^{-1} (Z) is closed in the space (X, τ, I). But every closed set in ideal topological space is $\alpha\omega I$-closed set. Henceforth h^{-1} (Z) is $\alpha\omega I$-closed set in ideal topological space (X, τ, I). Thus h is an $\alpha\omega I$-continuous in the ideal topological space. In general the converse of this theorem does not hold.

Example 4.3. Let X = {u,v,w}, τ = {φ, {v}, {v,w}, X} and Y = {u,v,w}, σ = {φ, {u,w}, {u}, X} and I = {φ, {v}}. Let h : $(X, \tau, I) \to (Y, \sigma)$ be the identity function defined by h(u) = u, h(v) = v, h(w) = w. Therefore Z is an $\alpha\omega I$-continuous but it is not a continuous.

Theorem 4.4. Every ω-continuous map in the ideal topological space (X, τ, I) is $\alpha\omega I$-continuous.

Proof: Let h be a continuous and let Z be a closed set of (Y, σ). Since h is continuous, then h^{-1} (Z) is ω-closed in the ideal topological space (X, τ, I). But every ω-closed set in ideal topological space is $\alpha\omega I$-closed set. Henceforth h^{-1} (Z) is $\alpha\omega I$-closed set in ideal topological space (X, τ, I). Thus h is an $\alpha\omega I$ continuous in ideal topological space. In general the converse of this theorem does not hold.

Example 4.5. Let X = {u,v,w}, τ = {φ, {v}, {v,w}, X} and Y = {u,v,w}, σ = {φ, {u,w}, {u}, X} and I = {φ, {v}}. Let h : $(X, \tau, I) \to (Y, \sigma)$ be the identity function defined by h(u) = u, h(v) = v, h(w) = w. Therefore Z is an $\alpha\omega I$-continuous but it is not a ω-continuous.

Theorem 4.6. Every $g^{\#}$- continuous map in the ideal topological space (X, τ, I) is $\alpha\omega I$-continuous.

Proof: Let h be a continuous and let Z be a closed set of (Y, σ). Since h is continuous, then h^{-1} (Z) is $g^{\#}$-closed in the ideal topological space (X, τ, I). But every $g^{\#}$- closed set in the ideal topological space is $\alpha\omega I$-closed set. Henceforth h^{-1} (Z) is an $\alpha\omega I$-closed set in ideal topological space (X, τ, I). Thus h is an $\alpha\omega I$ continuous in ideal topological space. In general the converse of this theorem does not hold.

Example 4.7. Let X = {u,v,w}, τ = {φ, {v}, {v,w}, X} and Y = {u,v,w}, σ = {φ, {u,w}, {u}, X} and I = {φ, {v}}. Let h : $(X, \tau, I) \to (Y, \sigma)$ be the identity function defined by h(u) = u, h(v) = v, h(w) = w. Therefore Z is an $\alpha\omega I$-continuous but it is not a $g^{\#}$-continuous.

Theorem 4.8. A mapping h : $(X, \tau, I) \to (Y, \sigma)$ is called $\alpha\omega I$-continuous iff h^{-1} (Z) is $\alpha\omega I$-closed set in the ideal topological space (X, τ, I) for every closed set D in (Y, σ).

Proof: Let D be any closed subset of (Y, σ). By assumption h^{-1} (D^{c}) = X-h^{-1} (D) is $\alpha\omega I$-open in X. Henceforth, h^{-1} (D) is $\alpha\omega I$-closed set in the ideal topological space (X, τ, I). In general the converse of this theorem can be true in the same way.

Theorem 4.9. A mapping h : (X, τ, I) → (Y, σ) is called $\alpha\omega I$ closed iff forevery subset S of Y and for each open set D containing h $^{-1}$ (S) there is a $\alpha\omega I$-open set D containing h $^{-1}$ (S), there is a $\alpha\omega I$-open set Z of Y such that S $\subseteq$ Z and h $^{-1}$ (Z) $\subseteq$ D.

Proof: Suppose h is $\alpha\omega I$-closed set in the ideal topological space (X, τ, I). Let S be a subset of Y. Let D be an open set of X such that h $^{-1}$ (S) $\subseteq$ D. Then Z = Y-h(X-D) is an $\alpha\omega I$-open set containing S such that h $^{-1}$ (Z) $\subseteq$ D. Conversely, suppose that E is a closed sets of the space (X, τ, I). Then h $^{-1}$ Y-h(E)) $\subseteq$ (X-E) and X-E is open. By hypothesis there is an $\alpha\omega I$-open set Z of Y such that Y-h(E) $\subseteq$ Z and h $^{-1}$ (Z) $\subseteq$ (X-E). Therefore, E $\subseteq$ h $^{-1}$ (Z)\$. Henceforth Y-Z $\subseteq$ h(E) $\subseteq$ h(X-h $^{-1}$ (Z)) $\subseteq$ Y-Z which implies h(E) = Y-Z. Since Y-W is $\alpha\omega I$-closed set in the space (X, τ, I). h(E) is $\alpha\omega I$-closed and h is $\alpha\omega I$-closed map.

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A NOTE ON AIG- CLOSURE AND AIG- INTERIOR IN IDEAL TOPOLOGICAL SPACES

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Abstract: The concepts of αIg- closure, αIg- interior and αIg- boundary of a subset of an ideal topological space (X, τ, I) are introduced in this article. Some of their basic properties are proven. Furthermore, the relationships between these sets are investigated to get the best of them. Also, it is established that αIg- closure is a Kuratowski closure operator on (X, τ, I) under certain conditions.

KEYWORDS.αIg- closed set, αIg- closure, αIg- interior, αIg- boundary.

1. Introduction

Topology is a branch of mathematics, which is believed that topological structure will be an important base for modification of knowledge extraction and processing. Kuratowski's closure complement theorem [1] has been a guiding source of topology. Peleg[2], while investigating the transitive closure of a binary relation, came across several closure operators which do not satisfy some of the four of Kuratowski's closure axioms, though their properties suffice to maintain "closure complement phenomenon". Similar kind of generalized closure operators are generated by the monotonic mappings introduced by A. Csaszar[3]. When several such operators are considered simultaneously and composed, the study of closure complement phenomenon becomes complicated and highly interesting.

The contributions of Hamlett and Jankovic[4-7] in ideal topological spaces initiated the generalization of some important properties in general topology via topological ideals. Kuratowski and Vaidhanathaswamy studied the notion of ideal topological spaces. Dontchev et al, Navaneethakrishnan et al, Jankovic et aletc., were investigated applications to various fields of ideal topology. The properties like decomposition of continuity, separation axioms, connectedness, compactness and resolvability [8-12] have been generalized using the concept of ideals in topological spaces. In [13], O. Njasted investigated the notion of α-closed sets. By using α-open sets, Mashhour et al.[14] defined and studied the concept of α-closed sets, α-closure of a set, α-continuity and α-closedness in topology. In the present note,we provide our investigations regarding all possible compositions of generalized closure operators and their corresponding interior operators in ideal topological spaces.

A topological space is a pair (X, τ) consisting of a set X and family τ of subsets of X satisfying the following conditions: a) $\phi \in$ and $X \in \tau$ b)τ is closed under arbitrary union c) τ is closed under finite intersection.The elements of X are called points of the space, the subsets of X belonging to τ are called open sets in the space, the complement of the subsets of X belonging to τ are called closed sets in the space. The τ-closure of a subset $A \subseteq$ X is denoted by cl(A) which is defined as the smallest closed subset of X which contains A. The τ-interior of a subset $A \subseteq$ X is denoted by int(A) which is defined as the union of all open subsets of X which contained in A. Note that A is open if and only if A = int(A). The boundary of a subset $A \subseteq$ X is denoted by b(A) and is given by

b(A) = cl(A)   int(A).

An ideal I on a set X is a nonempty collection of subsets of X which satisfies:

    a) $A \in$ I and $B \subseteq$ A implies that $B \in$ I and
    b) $A \in$ I, $B \in$ I implies that $A \cup B \in$ I.

An ideal topological space is a topological space (X, τ) with an ideal I on X and it is denoted by (X, τ, I). Given a topological space(X, τ) with an ideal I on X and if ρ(X) is the set of all subsets of X, a set operator (*):ρ(X)→ρ(X), is called a local function [15] of A with respect to τ and I, is defined as follows: for $A \subseteq$ X, A^*(X, I)= { x $\in$ U $\cap$ A $\notin$ I for every U $\in \tau$(x) where τ(x) = { U $\in \tau$(x)/ x$\in$ U}}. A Kuratowski closure operator cl^*(A) = A $\cup$ A^*(I, τ).

Definition 1.1.[17]Let (X, τ) be a topological space and I be an ideal on X. A subset A of X is said to be α-Ideal generalized closed set (αIg closed set) if $A^* \subseteq$ U whenever $A \subseteq$ U and U is α-open. The complement of αIg closed set is called α-Ideal generalized open set(αIg open set)

Definition 1.2.[18]Let (X, τ, I) be an ideal topological space and x $\in$ A $\subseteq$ X. Then A is said to be an Iα-neighborhood of x, if there exist an Iα-open set U such that x $\in$ U $\subseteq$ A, and simply write as IαN(x). If A is Iα-open set then it is Iα-open neighbourhood for any element x $\in$ A.

Definition 1.3.[18]Let (X, τ, I) be an ideal topological space and $x \in A \subseteq X$. Then x is said to be an Iα-interior point of A if A contain an Iα-open neighborhood set for x. The set of all Iα- interior points of A is called Iα-interior set and simply is denoted by Iα-int(A).

Definition 1.4.[18] Let (X, τ, I) be an ideal topological space and $A \subseteq X$. $x \in X$ is said to be an Iα-boundary point of A if for every Iα-open neighborhood set for x satisfies that the intersection with A and A^c is nonempty set. The set of all Iα-boundary points of A is called Iα-boundary set of A and simply is denoted by Iα-b(A).

2.αIg-CLOSURE

Definition 2.1. For every set $F \subseteq (X, \tau, I)$, αIg-closure of F is defined as the intersection of all αIg-closed sets containing F.(i.e.) αIg-cl(F) = $\cap$ {A : F $\subseteq$ A, A $\in \alpha$Ig-cl(X, τ, I)}.

Example 2.2. Let X = {a, b, c} with topology τ = {ϕ, {a}, {b, c}, X} and I = {ϕ, {c}}. Then αIg- closure of {b} is given as αIg-cl{b} = $\cap${{b}, {a, b}, X/ where {b}, {a, b}, X are αIg- closed set}.

Theorem 2.3. If αIg-cl(X, τ, I) is closed under finite union, then αIg-closure is a Kuratowski operator on (X, τ, I) .

Proof. (i) αIg-cl(ϕ) = ϕ and αIg-cl(X) = X also A $\subseteq \alpha$Ig-cl(A).

(ii) Suppose that E and F are two subsets of X, then αIg-cl(E) $\subseteq \alpha$Ig-cl(E $\cup$ F) andαIg-cl(F) $\subseteq \alpha$Ig-cl(E $\cup$ F). Hence αIg-cl(E) $\cup \alpha$Ig-cl(F) $\subseteq \alpha$Ig-cl(E $\cup$ F). If x $\notin \alpha$Ig-cl(E) $\cup \alpha$Ig-cl(F), then there exists A, B $\in \alpha$Ig-cl(X, τ, I) such that E $\subseteq$ A, x $\notin$ A, F $\subseteq$ B and x $\notin$ B. Hence E $\cup$ F $\subseteq$ A $\cup$ B and x $\notin$ A $\cup$ B. By hypothesis, A $\cup$ B is αIg-closed. Thus, x $\notin \alpha$Ig-cl(A $\cup$ B) implies that, x $\notin \alpha$Ig-cl(E $\cup$ F). Hence αIg-cl(E $\cup$ F) $\subseteq \alpha$Ig-cl(E) $\cup \alpha$Ig-cl(F). Thus, αIg-cl(E $\cup$ F) = αIg-cl(E) $\cup \alpha$Ig-cl(F).

(iii) Let E $\subseteq$ X and A be an αIg-closed set containing E. Then by Definition 2.1., αIg-cl(E) $\subseteq$ A and αIg-cl(αIg-cl(E)) $\subseteq$ A. Since αIg-cl(αIg-cl(E)) $\subseteq$ A, αIg-cl(αIg-cl(E)) $\subseteq \cap$ { A : E $\subseteq$ A, A $\in \alpha$Ig-cl(X, τ, I)}. Hence (αIg-cl(E)) $\subseteq \alpha$Ig-cl(αIg-cl(E)) and by Definition 2.1., αIg-cl(αIg-cl(E)) $\subset$ (αIg-cl(E)) implies that (αIg-cl(E)) = αIg-cl(αIg-cl(E)). Thus, αIg-closure is a Kuratowski closure operator on X.

Theorem 2.4. Let A be the subset of the ideal topological spaces (X, τ, I). Then x $\in \alpha$Ig-cl(A) if and only if A $\cap$ U $\neq \phi$ for every αIg-open set U containing x.

Proof. Suppose that x $\in \alpha$Ig-cl(A). Let U be an αIg-open set containing x such that A $\cap$ U = ϕ and so A $\subset$ X U. But X U is an αIg-closed set and so αIg-cl(A) $\subset$ X U. Since x $\notin$ X U, x $\notin \alpha$Ig-cl (A) which is contrary to the hypothesis.

Conversely, suppose that every αIg-open set of X containing x such that A $\cap$ U $\neq \phi$. If x $\notin \alpha$Ig-cl(A), then there exists an αIg-closed set F of X such that A $\subseteq$ F and x $\notin$ F. Hence x $\in$ X F and X F is an αIg-open set containing x. Thus, (X F) $\cap$ A = ϕ which is a contradiction.

3.αIg-INTERIOR

Definition 3.1. For every set A $\subseteq$ X, αIg-interior of A is defined to be the union of all αIg-open sets contained in A.(i.e.) αIg-int(A) = $\cup$ { U : U $\subseteq$ A, U $\in \alpha$Ig-int(X, τ, I)}.

Example 3.2. Let X = {a, b, c} with topology τ = {ϕ, {a}, {a, c}, X} and I = {ϕ, {b}}. Then αIg- interior of {a, b} is given as αIg-int{a, b} = $\cup$ {{b}, {a, b}/{b}, {a,b} are αIg-open set}

Theorem 3.3. Let (X, τ, I) be an ideal topological space and A be a subset of X, then the following statements are true.

(i) X − (αIg-int(A)) = αIg-int(X −A).

(ii) αIg-int(A) = X − (αIg-int(X −A)).

(iii) αIg-cl(A) = X − (αIg-int(A)).

Proof. (i) Let x $\in$ X − (αIg-int(A)). Thenx $\notin$ (αIg-int(A)). That is, every αIg-open set U containing x is such that U is not a proper subset of A. Thus, U $\cap$ (X − A) $\neq \phi$, for everyαIg-open set U containing x. Hence, x $\in \alpha$Ig-int(X − A) and so X − (αIg-int(A)) $\subseteq \alpha$Ig-int(X − A). Conversely, suppose x $\in \alpha$Ig-int(X − A). Then, U $\cap$ (X A) $\neq \phi$, for every αIg-open set U containing x. By Definition3.1., x $\notin$ (αIg-int(A)). Thus, x $\in$ X − (αIg-int(A)) and so (αIg-int(X −A)) $\subseteq$ X − (αIg-int(A)). Therefore,X − (αIg-int(A)) = αIg-int(X − A).

(ii) From (i), X − (αIg-int(A)) = αIg-int(X −A). By taking the complement on both sides, we get (X − (X − αIg-int(A))) = (X − αIg-int(X − A)) implies that αIg-int(A) = X − (αIg-int(X −A)).

(iv) From (i), X − (αIg-int(A) = αIg-int(X − A). Replace A by X − A, we get X − (αIg-int(X −A)) = X − αIg-int((X −A)) which implies that αIg-cl(A) = X − (αIg-int(X − A)).

4.αIg-BOUNDARY

Definition 4.1. Consider an ideal topological space (X, τ, I). Let A be any subset of (X, τ, I). Then, the αIg-boundary of A is defined as αIg-Bd(A) = αIg-cl(A) ∩αIg-cl(X − A).

Theorem 4.2. For any sets A and B in ideal topological space (X, τ, I), the following conditions hold:

    (i) αIg-Bd(A) = αIg-Bd(X − A).

    (ii) αIg-Bd(A) ⊆αIg-cl(A) .

    (iii) αIg-Bd(A) ⊆αIg-cl(X − A) .

    (iv) If A is an αIg-closed set, then αIg-Bd(A) ⊆ A.

    (v) If A is an αIg-open set, then αIg-Bd(A) ⊆ X − A.

    (vi) Let A ⊆ B and B ∈αIg-cl (X, τ) (resp. B ∈αIg-O(X, τ)). Then, αIg-Bd(A) ⊆ B (resp. αIg-Bd(A) ⊆B^c), where αIg-cl(X, τ) denotes the class of αIg-closed (resp. αIg-O(X, τ) denotes the class of αIg-open) sets in X.

    (vii) X − (αIg-Bd(A)) = αIg-int (A) ∪αIg-int (X − A).

Proof. (i) αIg-Bd(A) = αIg-cl(A) ∩αIg-cl(X − A) = αIg-cl(X − A) ∩αIg-Cl(A) = αIg-cl(X − A) ∩ (X − αIg-cl(X − A)) = αIg-Bd(X − A).

(ii) By definition 4.1, αIg-Bd(A) = αIg-cl(A) ∩αIg-cl(X − A). Hence αIg-Bd(A) ⊆αIg-cl(A).

(iii) By definition 4.1, αIg-Bd(A)=αIg-cl(A) ∩αIg-cl(X − A). ThusαIg-Bd(A) ⊆αIg-cl(X − A).

(iv) αIg-Bd(A) = αIg-cl(A) ∩αIg-cl(X − A) ⊆αIg-cl(A) = A.

(v) If A is αIg-open then, X − A is αIg-closed. By (iv), αIg-Bd(X − A) ⊆ X − A. Again by (i), αIg-Bd(A) ⊆ X − A.

(vi) Since A ⊆ B, αIg-cl(A) ⊆αIg-cl(B). Now, αIg-Bd(A) = αIg-cl(A) ∩αIg-cl(X − A) ⊆αIg-cl(A) ⊆αIg-cl(B) = B. Hence αIg-Bd(A) ⊆ B.

(vii) X − (αIg-Bd(A)) = X − (αIg-cl(A) ∩αIg-cl(X − A)) = X − (αIg-cl(A)) ∪ X − (αIg-cl(X − A)) = (αIg-int(X − A)) ∪ X − (αIg-int(X − A)) = αIg-int(X − A)) ∪αIg-int(A).

Definition 4.3. Let (X, τ, I) be an ideal topological space and A ⊆ X. Then, αIg-border of A is defined as bαIg(A) = A   αIg-int(A).

Theorem 4.4. For a subset A of an ideal topological space (X, τ, I), the following conditions hold:

    (i) αIg-Bd(A) ⊆Bd(A), where Bd(A) denotes the boundary of A.

    (ii) αIg-cl (A) = αIg-int(A) ∪αIg-Bd(A)

    (iii) αIg-int(A) ∩αIg-Bd(A) = ϕ

    (iv) bαIg (A) ⊆αIg-Bd(A)

    (v) αIg-Bd(int (A)) ⊆αIg-Bd(A)

    (vi) αIg-Bd(cl (A)) ⊆αIg-Bd(A) .

Proof. (i) αIg-Bd(A) = αIg-cl (A) ∩αIg-cl (X − A) ⊆ cl(A) ∩ cl(X − A) = Bd (A).

(ii) αIg-int(A) ∪αIg-Bd(A) = αIg-int(A) ∪ (αIg-cl (A) ∩αIg-cl (X − A)) = αIg-cl (A).

(iii) αIg-int(A) ∩αIg-Bd(A) = αIg-int(A) ∩ (αIg-cl (A) ∩αIg-cl (X − A)) = ϕ.

(iv) bαIg (A) = A   αIg-int(A) ⊆αIg-cl (A)   αIg-int(A) ⊆αIg-cl (A) ∩ X − (αIg-int(A)) ⊆αIg-cl (A) ∩αIg-cl(X − A) = αIg-Bd(A).

(v) αIg-Bd(int (A)) = αIg-cl(int (A)) ∩ X − αIg-cl(int (A)) ⊆αIg-cl((A)) ∩ X − (αIg-int (A))   = αIg-Bd(A).

(vi) αIg-Bd(Cl(A)) = αIg-cl(cl(A)) ∩αIg-cl(cl(A))c = αIg-cl(A) ∩ (αIg-int(cl(A))) ⊆αIg-cl(A) ∩ X − (αIg-int(A)) = αIg-Bd(A).

5. CONCLUSION

In this present work, we introduced the new concepts αIg- closure, αIg- interior and αIg- boundary of a subset of an ideal topological space (X, τ, I). Also we studied and proved the basic properties of these concepts

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On generalized star $\omega\alpha I$-closed sets in ideal topological spaces *

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Abstract   In this paper, we introduce a new class of sets named as generalized star $\omega\alpha I$-closed sets in ideal topological spaces and study some of their properties. Further we also define and study the concept of $\omega\alpha I$-open sets in ideal topological spaces and discuss their properties.

Key words ω-closed sets, $\omega\alpha I$-closed sets, $\omega\alpha I$-open sets.

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1 Introduction

In [7, 13] the theory of ideal topological spaces was introduced by Kuratowski and Vaidyanathswamy. Ideals in topological space have been considered since 1930. In the year 1990 Jankovic and Hamlett [6] obtained new topologies using older ones and introduced I-open sets in ideal topological spaces which initialized the application of topological ideals in the generalization of most fundamental properties in general topology.

An ideal I is a nonempty collection of subsets of X closed with respect to a finite union. (X, τ, I) is an ideal topological space (ITS) and, in short, it is called an ideal space. For a subset A of X, the local function of A is defined as: $A^* = \{x \in X : U \cap A$ does not belong to I for every $U \in \tau(x)\}$, where $\tau(x)$ is the collection of all nonempty open sets containing x. From this point onwards now we simply write A^* instead of $A^*(I)$ to avoid any chance of confusion. A Kuratowski closure operator $\mathrm{cl}^*(.)$ for a topology $\tau^*(I, \tau)$ is termed as a *-topology, finer than τ, and is determined by $\mathrm{cl}^*(A) = A \cup A^*$. If $A \subseteq X$, $\mathrm{cl}(A)$ and $\mathrm{int}(A)$ will denote the closure and interior of A in (X, τ) respectively and $\mathrm{cl}^*(A)$ and $\mathrm{int}^*(A)$ will denote the closure and interior of A respectively in $(X, ^*\tau)$.

In 2013 Carpintero et al. [1] introduced the concept of the generalization of ω-closed sets via operators and ideals. In 2014 Maragathavalli and Vinodhini [8] introduced the concept of α-generalized closed sets in ideal topological spaces.

In 2016, Ravi et al. [10] presented the concept of $g^{\#}$- closed sets in ideal topological spaces. In 2008 Navaneethakrishnan and Joseph [9] introduced the concept G-closed sets in ideal topological spaces. In 2002 Hatir and Noiri [4] presented the concept of decomposition of continuity via idealization. In 1996

Dontchev [2] discussed about pre-I-open sets with reference to a decomposition of I-continuity. The aim of this paper is to extend the notion of sets in ideal topological spaces by introducing the concept of the $\omega\alpha I$-closed sets in ideal topological spaces and to study some of their basic properties.

2 Preliminaries

Throughout this paper (X, τ) represent topological spaces. For a subset A of a space (X, τ), $\mathrm{cl}(A), \mathrm{int}(A)$ denote the closure of A and the interior of A respectively. We recall the following definitions.

Definition 2.1. [6] Let (X, τ) be a topological space. Let I be an ideal defined on X. Then the space (X, τ, I) is termed as an ideal topological space, which satisfies the following two conditions:

1. If $A \in I$ and $B \subseteq A \Rightarrow B \in I$.
2. If $A \in I$ and $B \in I$, then $A \cup B \in I$.

Definition 2.2. [5, 6] A subset A of an ideal topological space (X, τ, I) is termed as

1. a pre-I-closed set if $\mathrm{cl}^*(\mathrm{int}(A)) \subseteq A$. If $A \subseteq (\mathrm{int}(\mathrm{cl}^*(A))$ then A is called a pre-I-open set.
2. a semi-I-closed set if $\mathrm{int}(\mathrm{cl}^*(A)) \subseteq A$. If $A \subseteq (\mathrm{cl}^*(\mathrm{int}(A))$ then A is called a semi-I-open set.
3. an α-I-closed set if $\mathrm{cl}^*(\mathrm{int}(\mathrm{cl}^*(A))) \subseteq A$. If $A \subseteq (\mathrm{int}(\mathrm{cl}^*(\mathrm{int}(A)))$ then A is called an α-I-open set.
4. a β-I-closed set if $(\mathrm{int}(\mathrm{cl}^*(\mathrm{int}(A))) \subseteq A$. If $A \subseteq (\mathrm{cl}^*(\mathrm{int}(\mathrm{cl}^*(A)))$ then A is called a β-I-open set.
5. a regular-I-closed set if $A = \mathrm{cl}^*(\mathrm{int}(A))$. If $A = (\mathrm{int}(\mathrm{cl}^*(A))$ then A is called a regular-I-open set.

Lemma 2.3. [6] Let (X, τ, I) be an ideal topological space. Let A, B be subsets of X. Then the following properties hold:

1. $A \subseteq B \Rightarrow A^* \subseteq B^*$,
2. $A^* = \mathrm{cl}(A^*) = \mathrm{cl}(A) = \mathrm{cl}^*(A)$,
3. $(A \cup B)^* = A^* \cup B^*$,
4. $(A \cap B)^* \subseteq A^* \cap B^*$,
5. $(A^*)^* \subseteq A^*$.

Definition 2.4. [3, 5, 6, 8–12, 14, 15] A subset A of a topological space X is said to be:

1. a generalized closed ($-$closed) set if $\mathrm{cl}(A) \subseteq U$ whenever A is a subset of U and U is open in the space X; a g-open set is the complement of a g-closed set.
2. generalized pre regular-closed (gpr-closed) set if $\mathrm{pcl}(A) \subseteq U$ whenever A is a subset of U and U is regular open in the space X.
3. an ω-closed set if $\mathrm{cl}(A) \subseteq U$ whenever A is a subset of U and U is semi-open in the space X.
4. a $\hat{g}$-closed set if $\mathrm{cl}(A) \subseteq U$ whenever A is a subset of U and U is semi-open in the space X.
5. a $g^{\#}$-closed set if $\mathrm{cl}(A) \subseteq U$ whenever A is a subset of U and U is g-open in the space X.
6. an α generalized closed (αg-closed) set if $\alpha\mathrm{cl}(A) \subseteq U$ whenever A is a subset of U and U is open in the space X.
7. a generalized pre-closed (gp-closed) set if $\mathrm{pcl}(A) \subseteq U$ whenever A is a subset of U and U is open in the space X.
8. a regular generalized closed (rg-closed) set if $\mathrm{cl}(A) \subseteq U$ whenever A is a subset of U and U is regular open in the space X.
9. a generalized semi-pre-closed (gsp-closed) set if $\mathrm{spcl}(A) \subseteq U$ whenever A is a subset of U and U is open in the space X.
10. a strongly g-closed (g^*-closed) set if $\mathrm{cl}(A) \subseteq U$ whenever A is a subset of U and U is g-open in the space X.
11. a generalized star pre-closed (g^*p-closed) set if $\mathrm{pcl}(A) \subseteq U$ whenever A is a subset of U and U is g-open in the space X.
12. a pre generalized star closed (pg^*-closed) set if $\mathrm{pcl}(A) \subseteq U$ whenever A is a subset of U and U is $\omega\alpha$-open in the space X.

3 On generalized star $\omega\alpha I$-closed sets in ideal topological spaces

In this section we introduce the concept of $\omega\alpha I$-closed set and study some of their properties.

Definition 3.1. A subset B of an ideal topological space (X, τ, I) is called a generalized star $\omega\alpha I$-closed (briefly $g^*\omega\alpha I$-closed)set if $B^* \subseteq D$ whenever B is a subset of D (i.e., $B \subseteq D$) and D is $\omega\alpha$-open in the space.

Example 3.2. Let $X = \{u, v, w\}$ and $I = \{\emptyset, \{v\}\}$. Take $\tau = \{\emptyset, \{u\}, \{v, w\}, X\}$ and $\tau^c = \{\emptyset, \{v, w\}, \{u\}, X\}$. Therefore, $g^*\omega\alpha I$ closed sets of X are $\{\emptyset, \{u\}, \{w\}, \{v, w\}, \{u, w\}, X\}$. Here $B = \{v\}$ is a $g^*\omega\alpha$-closed set but it is not a $g^*\omega\alpha I$-closed set.

Example 3.3. Let $X = \{u, v, w\}$ and $I = \{\emptyset, \{v\}\}$. Take $\tau = \{\emptyset, \{u, v\}, X\}$ and $\tau^c = \{\emptyset, \{w\}, X\}$. Therefore, $g^*\omega\alpha I$ closed sets of X are $\{\emptyset, \{w\}, \{v, w\}, \{u, w\}, X\}$. Here $B = \{u, w\}$ is a $g^*\omega\alpha I$-closed set but it is not a $g^*\omega\alpha$-closed set.

Theorem 3.4. *Every regular closed set in the ideal topological space (X, τ, I) is $g^*\omega\alpha I$-closed.*

Proof. Let B be a regular closed set in the ideal topological space (X, τ, I). Let D be any $\omega\alpha$-open set in X such that $B^* \subseteq D$. Since every open set is $\omega\alpha$-open, so $B^* \subseteq \operatorname{cl}(B) \subseteq D$. Now, $B^* \subseteq \operatorname{cl}^*(B) \subseteq \operatorname{cl}(B) \subseteq D$. This shows that B is a $g^*\omega\alpha I$-closed set. Hence every regular closed set in the ideal topological space is a $g^*\omega\alpha I$-closed set. In general the converse of this theorem does not hold. $\qquad\square$

Example 3.5. Let $X = \{u, v, w\}$ and $I = \{\emptyset, \{v\}\}$. Take $\tau = \{\emptyset, \{u\}, \{v, w\}, X\}$ and $\tau^c = \{\emptyset, \{v, w\}, \{u\}, X\}$. Therefore, $g^*\omega\alpha I$-closed sets of X are $\{\emptyset, \{u\}, \{w\}, \{v, w\}, \{u, w\}, X\}$. Here $B = \{u, w\}$ is a $g^*\omega\alpha I$-closed set but it is not a regular closed set.

Theorem 3.6. *Every αg-closed, gp-closed, gsp-closed, gpr-closed, rg-closed, g^*p-closed, and pre g^*-closed set in the space is $g^*\omega\alpha I$-closed set in the ideal topological space (X, τ, I).*

Proof. It follows from that, every open set is $\omega\alpha$-open set in the space (X, τ, I). In general the converse of this theorem does not hold. $\qquad\square$

Example 3.7. Let $X = \{u, v, w\}$ and $I = \{\emptyset, \{v\}\}$. Take $\tau = \{\emptyset, \{u\}, \{v\}, \{u, v\}, X\}$ and $\tau^c = \{\emptyset, \{v, w\}, \{u, w\}, \{w\}, X\}$. Therefore, $g^*\omega\alpha I$ closed sets of X are $\{\emptyset, \{u\}, \{w\}, \{v, w\}, \{u, w\}, X\}$. Here $B = \{u\}$ is a $g^*\omega\alpha I$-closed set but it is not an αg-closed, gp-closed, gsp-closed, gpr-closed, rg-closed, g^*p-closed, and pre g^*-closed set.

Theorem 3.8. *The class of $g^*\omega\alpha I$-closed set in the ideal topological space (X, τ, I) is independent of the class of α-closed, semi-closed, $\omega\alpha$-closed, g-closed and g^*-closed sets in the space (X, τ, I).*

Proof. The proof is obvious from the definitions mentioned in the Preliminaries (section 2). $\qquad\square$

Example 3.9. Let $X = \{u, v, w\}$ and $I = \{\emptyset, \{w\}\}$. Take $\tau = \{\emptyset, \{w\}, \{u, w\}, X\}$ and $\tau^c = \{\emptyset, \{u, v\}, \{v\}, X\}$. Therefore, $g^*\omega\alpha I$ closed sets of X are $\{\emptyset, \{v\}, \{u, v\}, \{v, w\}, X\}$. Here $B = \{u\}$ is an α-closed, semi-closed, $\omega\alpha$-closed set but it is not a $g^*\omega\alpha I$-closed set.

Example 3.10. Let $X = \{u, v, w\}$ and $I = \{\emptyset, \{v\}\}$. Take $\tau = \{\emptyset, \{u\}, \{v, w\}, X\}$ and $\tau^c = \{\emptyset, \{v, w\}, \{u\}, X\}$. Therefore, $g^*\omega\alpha I$ closed sets of X are $\{\emptyset, \{u\}, \{w\}, \{v, w\}, \{u, w\}, X\}$. Here $B = \{u, w\}$ is a $g^*\omega\alpha I$-closed set but it is not an α-closed, semi-closed, $\omega\alpha$-closed set.

Example 3.11. Let $X = \{u, v, w\}$ and $I = \{\emptyset, \{v\}\}$. Take $\tau = \{\emptyset, \{u\}, \{v\}, \{u, v\}, X\}$ and $\tau^c = \{\emptyset, \{v, w\}, \{u, w\}, \{w\}, X\}$. Therefore, $g^*\omega\alpha I$ closed sets of X are $\{\emptyset, \{u\}, \{w\}, \{v, w\}, \{u, w\}, X\}$. Here $B = \{u\}$ is a $g^*\omega\alpha I$-closed set but it is not a g-closed and a g^*-closed set.

Theorem 3.12. *The union of two $g^*\omega\alpha I$-closed sets is a $g^*\omega\alpha I$-closed set in any ideal topological space (X, τ, I).*

Proof. Let M and N be two $g^*\omega\alpha I$-closed sets in an ideal topological space (X, τ, I). Let D be an $\omega\alpha$-open set in the space, such that $M \cup N \subseteq D$. Then $M \subseteq D$ and $N \subseteq D$. Since M and N are $g^*\omega\alpha I$-closed sets, $M^* \subseteq D$ and $N^* \subseteq D$ whenever $M^* \cup N^* \subseteq (M \cup N)^* \subseteq D$, D is $\omega\alpha$-open. Hence, $M \cup N$ is $g^*\omega\alpha I$-closed set in the ideal topological space. $\square$

Theorem 3.13. *If a subset B of a space X is $g^*\omega\alpha I$-closed in the ideal topological space (X, τ, I), then $B^* - B$ does not contain any non empty closed set in the space.*

Proof. Let E be a closed set contained in $B^* - B$, such that $B^* - B \subseteq X - E$ and $X - E$ is open, so that we have an $\omega\alpha$-open set with $B \subseteq X - E$. But B is $g^*\omega\alpha I$-closed in the ideal topological space. Therefore, $B^* \subseteq X - E$, consequently $E \subseteq X - B^*$. Then $E \subseteq B^*$. Thus $E \subseteq B^* \cap (X - B^*) = \emptyset$. That is, $E = \emptyset$. Hence the proof. $\square$

Theorem 3.14. *If a subset B of a space X is $g^*\omega\alpha I$-closed in the ideal topological space (X, τ, I), then $B^* - B$ does not contain any non empty $\omega\alpha$-closed set in the space.*

Proof. The proof follows from Theorem 3.13 and the fact that every closed set is a $g^*\omega\alpha I$-closed set in the space (X, τ, I). $\square$

Example 3.15. Let $X = \{p, q, r, s\}, I = \{\emptyset, \{q\}\}$ and $\tau = \{\emptyset, \{r, s\}, X\}$. Then let (X, τ) be a topological space and I be an ideal. Consider the set $B = \{p, r\}$ then $B^* - B = X - \{p, r\} = \{q, s\}$. It does not contain any non empty $\omega\alpha$-closed set. But B is not a $g^*\omega\alpha I$-closed set in the ideal topological space (X, τ, I).

Theorem 3.16. *If B is $\omega\alpha$-open and $g^*\omega\alpha I$-closed set of the space (X, τ, I), then B is closed set of the space (X, τ, I).*

Proof. Let B be an $\omega\alpha$-open and a $g^*\omega\alpha I$-closed set in the ideal topological space (X, τ, I). Then $B^* \subseteq B$. Hence, B is closed. $\square$

Theorem 3.17. *If B is a $g^*\omega\alpha I$-closed set in the ideal topological space (X, τ, I), then B is closed iff $B^* - B$ is $\omega\alpha$-closed in the space.*

Proof. Let B be a closed subset of the ideal topological space (X, τ, I). Then $B^* = B$ and so $B^* - B = \emptyset$, which is $\omega\alpha$-closed. Conversely, suppose $B^* - B$ is $\omega\alpha$-closed. Since, B is $g^*\omega\alpha I$-closed in the ideal topological space (X, τ, I), by Theorem 3.14 $B^* - B$ does not contain any non empty $\omega\alpha$-closed set which implies that $B^* - B = \emptyset$. That is $B^* - B = \emptyset \Rightarrow B^* = B$. Hence, B is closed. $\square$

Theorem 3.18. *If B is $g^*\omega\alpha I$-closed set in the ideal topological space (X, τ, I) and $B \subseteq C \subseteq B^*$ then C is also $g^*\omega\alpha I$-closed set in the space.*

Proof. Let D be an $\omega\alpha$-open set in the space (X, τ, I) such that $C \subseteq D$ then $B \subseteq D$. Since, $B \subseteq D$ and D is $\omega\alpha$-open set then $B^* \subseteq D$. Then $B^* \subseteq \mathrm{cl}^*(B) = B^*$. Since $C \subseteq B^*$, thus $C^* \subseteq B^* \subseteq D$. Hence C is $g^*\omega\alpha I$-closed set in the ideal topological space (X, τ, I). In general the converse of this theorem does not hold. $\square$

Example 3.19. Let $X = \{u, v, w\}, I = \{\emptyset, \{w\}\}$ and $\tau = \{\emptyset, \{w\}, \{u, w\}, X\}$. Let (X, τ) be a topological space and I be an ideal. The $g^*\omega\alpha I$-closed sets of X are $\{\emptyset, \{v\}, \{u, v\}, \{v, w\}, X\}$. Consider the set $B = \{v\}$ and $C = \{v, w\}$ such that B and C are $g^*\omega\alpha I$-closed sets in the ideal topological space (X, τ, I) but $B \subseteq C$ is not contained in B^*.

Theorem 3.20. *Let $B \subseteq Y \subseteq X$ and if B is $g^*\omega\alpha I$-closed set in the ideal topological space (X, τ, I), then B is $g^*\omega\alpha I$-closed relative to Y.*

Proof. Let $B \subseteq Y \cap D$ where D is an $\omega\alpha$-open set in the space (X, τ, I). Then $B \subseteq D$ and hence $B^* \subseteq D$. This implies that $Y \cap B^* \subseteq Y \cap D$. Thus B is a $g^*\omega\alpha I$-closed set in the space (X, τ, I) relative to Y. $\square$

Theorem 3.21. *If a subset B of a topological space X is both semi-open and an ω-closed set then it is a $g^*\omega\alpha I$-closed set in the ideal topological space (X, τ, I).*

Proof. Let B be a semi-open and ω-closed set in the space (X, τ, I). Let $B \subseteq D$ and D be an $\omega\alpha$-open set in the space (X, τ, I). Now $B \subseteq B$, by hypothesis, $B^* \subseteq B$ then $B^* \subseteq B \subseteq D$. Thus B is a $g^*\omega\alpha I$-closed set in the ideal topological space (X, τ, I). If B is both semi-open and $g^*\omega\alpha I$-closed set in the space (X, τ, I) then, B need not be an ω-closed set as can be seen from the Example 3.22 below. $\qquad\square$

Example 3.22. Let $X = \{u, v, w\}$ and $I = \{\emptyset, \{v\}\}$. Take $\tau = \{\emptyset, \{u\}, \{v\}, \{u, v\}, X\}$ and $\tau^c = \{\emptyset, \{v, w\}, \{u, w\}, \{w\}, X\}$. Therefore, $g^*\omega\alpha I$ closed sets of X are $\{\emptyset, \{u\}, \{w\}, \{v, w\}, \{u, w\}, X\}$. Here $B = \{u\}$ is a semi-open and a $g^*\omega\alpha I$- closed set but it is not an ω-closed set.

4 Generalized star $\omega\alpha I$-open sets in ideal topological spaces

Definition 4.1. A subset B of a topological space (X, τ, I) is said to be a generalized star $\omega\alpha I$-open (or, briefly, a $g^*\omega\alpha I$-open) set if its complement is a $g^*\omega\alpha I$-closed set in the space (X, τ, I).

Theorem 4.2. *A subset B of a topological space X is $g^*\omega\alpha I$-open iff $D \subseteq \text{int}^*(B)$ whenever D is $\omega\alpha$-closed and $D \subseteq B$.*

Proof. Assume that B is a $g^*\omega\alpha I$-open set in the ideal topological space (X, τ, I) and D is an $\omega\alpha$-closed set such that $D \subseteq B$. Then $X - B$ is a $g^*\omega\alpha I$-closed set in the ideal topological space (X, τ, I). Moreover, $X - B \subseteq X - D$ and $X - D$ is an $\omega\alpha$-open set in the space X. This implies that $\text{cl}^*(X - B) \subseteq X - D$. But $\text{cl}^*(X - B) = X - \text{int}^*(B)$. Thus $X - \text{int}^*(B) \subseteq X - D$. So $D \subseteq \text{int}^*(B)$. Conversely, suppose $D \subseteq \text{int}^*(B)$ whenever D is an $\omega\alpha$-closed set and $D \subseteq B$. To prove that B is $g^*\omega\alpha I$-open in the ideal topological space (X, τ, I). Let J be an $\omega\alpha$-open set of the space X such that $X - B \subseteq J$, then $X - J \subseteq B$. Now $X - J$ is a $g^*\omega\alpha I$-closed set containing B, so that $X - J \subseteq \text{int}^*(B), X - \text{int}^*(B) \subseteq J$ but $\text{cl}^*(X - B) = X - \text{int}^*(B)$. Thus $\text{cl}^*(X - B) \subseteq J$, that is $X - B$ is a $g^*\omega\alpha I$-closed set in the ideal topological space (X, τ, I). Hence B is a $g^*\omega\alpha I$-open set in the ideal topological space (X, τ, I). $\qquad\square$

Theorem 4.3. *If $\text{int}^*(B) \subseteq C \subseteq B$ and B is $g^*\omega\alpha I$-open set in the space, then C is $g^*\omega\alpha I$-open set in the ideal topological space (X, τ, I).*

Proof. If $\text{int}^*(B) \subseteq C \subseteq B$, then $X - B \subseteq X - C \subseteq X - \text{int}^*(B) = \text{cl}^*(X - B)$. Since, $X - B$ is a $g^*\omega\alpha I$-closed set, then by Theorem 3.18, $X - C$ is also a $g^*\omega\alpha I$-closed set in the ideal topological space (X, τ, I). Therefore, C is a $g^*\omega\alpha I$-open set in the ideal topological space (X, τ, I). $\qquad\square$

Theorem 4.4. *If B is a $g^*\omega\alpha I$-closed set in the space, then $B^* - B$ is a $g^*\omega\alpha I$-open set in the ideal topological space (X, τ, I).*

Proof. Let B be a $g^*\omega\alpha I$-closed set in the ideal topological space (X, τ, I). Let E be an $\omega\alpha$-open set such that $E \subseteq B$. Since B is $g^*\omega\alpha I$-closed, then by Theorem 3.13, $B^* - B$ does not contain any non empty closed set in the space. Thus $E = \emptyset$. Then $E \subseteq \text{int}^*(B^* - B)$. Therefore by Theorem 3.4, $B^* - B$ is a $g^*\omega\alpha I$-open set in the ideal topological space (X, τ, I). $\qquad\square$

Theorem 4.5. *A subset B is $g^*\omega\alpha I$-open set in the ideal topological space (X, τ, I) iff $J = X$ every time J is $\omega\alpha$-open and $\text{int}^*(B) \cup (X - J) \subseteq J$.*

Proof. Let B be a $g^*\omega\alpha I$-open set in the ideal topological space (X, τ, I). Let D be an $\omega\alpha$-open set and $\text{int}^*(B) \cup (X - D) \subseteq D$. This gives $X - D \subseteq (X - \text{int}^*(B)) \cap (X - (X - B)) = X - \text{int}^*(B) - (X - B) = \text{cl}^*(X - B) - (X - B)$. Since $X - B$ is $g^*\omega\alpha I$-closed and $X - D$ is $\omega\alpha$-closed in the space (X, τ, I), then by Theorem 3.13 it follows that $X - D = \emptyset$. Therefore, $X = D$. Conversely, suppose E is $\omega\alpha$-closed and $E \subseteq B$. Then $\text{int}^*(B) \cup (X - B) \subseteq \text{int}^*(B) \cup (X - E)$. It follows that $\text{int}^*(B) \cup (X - E) = X$ and hence, $E \subseteq \text{int}^*(B)$. Therefore, B is $g^*\omega\alpha I$-open in the ideal topological space (X, τ, I). $\qquad\square$

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On the degenerate Elzaki transform *

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Abstract   Based on the Fourier transform, Elzaki in 2011 (Tarig M.Elzaki, The new integral transform Elzaki transform , Global Journal of Pure and Applied Mathematics, 7(1), 57–64 (2011)) defined the Elzaki transform. Motivated by the work Kim and Kim (Taekyun Kim and Dae San Kim, Degenerate Laplace transform and degenerate gamma function, Russian Journal of Mathematical Physics, 24(2), 241–248 (2017)) on the introduction of the degenerate Laplace transform, in this paper, we introduce the degenerate ELzaki transform and investigate some of its properties and relations. In particular we find the degenerate Elzaki transforms of the degenerate sine, the degenerate cosine, the degenerate hyperbolic sine and the degenerate hyperbolic cosine functions. Moreover, we investigate a scale preserving theorem for the degenerate Elzaki transform and establish that the degenerate Elzaki transform is a theoretical dual transform to the degenerate Laplace transform.

Key words   degenerate Elzaki transform, Upadhyaya transform, degenerate Upadhyaya transform.

2020 Mathematics Subject Classification   44A10 44A30 44A35.

1 Introduction

In mathematics, the various transforms are often applied as a valuable tool for transforming a differential equation from one form to another form to make it easy to handle and thus amenable to solution. The

well known Laplace transform, propounded by Pierre Simon Laplace around 1780, is very widely used extensively for this purpose in almost all branches of mathematics, engineering, physical and social sciences and the like, just to mention a few. As most of us are very well aware that the Laplace transform converts a higher order differential equation into a polynomial form, with the incorporation of the initial values and the boundary conditions from the very beginning, which is far easier to solve than solving the original differential equation directly. The concept of Laplace transformation plays a vital role in diverse areas of science and technology such as electric analysis, communication engineering, control engineering, linear system, analysis, statistics, optics, quantum physics, solution of partial differential operation, data mining, machine learning, signal processing, integrated circuits, etc. The major advantage of Laplace transform is that, it is defined for both the stable and the unstable systems. Particularly, the Laplace transform is heavily used in signal processing to transform the signal in time domain into a signal in a complex frequency domain and it is used for the easy analysis of signals and systems.

In control systems, the Laplace transform is used to manage the commands, it directs or regulates the behavior of other devices or systems. The Laplace transform converts the governing differential equations of a system or its components into simple algebraic forms allowing the control engineers to describe the system, in particular, a closed loop system as a chain of connected functional blocks. Machine learning focuses on prediction, based on known properties learned from the training data, in which the Laplace transform is used to determine the prediction and to analyze the step of knowledge in databases. Also, the Laplace transformation helps us to find out the current or charge flowing through an electrical circuit and it provides us some criteria for the analyzing the circuits. It is used to manufacture the required ICs and chips for computer systems. Thus, in short, we can say that the Laplace transform plays a vital role in almost all the areas of science and technology.

As our technology is advancing day by day, in order to find either the exact or numerical solutions of the mathematical differential equations encountered in this process, various variants of the classical Laplace transforms are proposed by many mathematicians over the past about three decades, which have extensively been applied to a very diverse variety of phenomenon in natural, physical and applied sciences besides economic and social sciences. An exhaustive description of almost all these new variants of the classical Laplace transforms existing in the mathematics research literature today can be found in the seminal work of Upadhyaya [18] on Upadhyaya transform, which is the most general and the most robust variant of the classical Laplace transform as it unifies and generalizes almost all the variants of the classical Laplace transform that today exist in the mathematics literature, as far as known to us, right almost up to the year 2021 itself by the time of writing of this paper by us (see also, Upadhyaya [19]).

Among the many variants of the classical Laplace transform existing in the literature, a very effective method to get the solution of differential and integral equations and a linear system of differential and integral equations is the Elzaki transform method introduced by Elzaki in 2011 [3] which is based on the Fourier transform, and it can still serve as an auxiliary method of solving the problems of engineering and applied sciences in addition to the Laplace transform. The Elzaki transform may be used to solve intricate problems in almost all the areas of sciences and applied sciences without resorting to a new frequency domain [3–10, 13, 20].

In 2017 Kim and Kim [12] defined and studied some properties of the degenerate gamma function and they also introduced for the first time the concept of the degenerate Laplace transform and obtained some of its properties. This work of Kim and Kim [12] was extended by the third author in a series of papers [14–17]. Very recently Duran [1] has defined and studied the properties of the degenerate Sumudu transform. In this paper we introduce the degenerate Elzaki transform and study a number of its properties which also includes the relationship between the degenerate Laplace transformation and the degenerate Elzaki transformation, which we call the duality relation between the degenerate Laplace transform and the degenerate Elzaki transform. We also mention here that the third author has already introduced the concept of the more general and versatile transform - the degenerate Upadhyaya transform in [18], therefore, the degenerate Elzaki transform, which we introduce in this paper and the degenerate Sumudu transform introduced by Duran [1] are both *particular cases* of the already introduced degenerate Upadhyaya transform [18] (see also Upadhyaya et al. [19, Remark 3.2, p. 35]).

2 Preliminaries

In this section we present the definitions of the Elzaki transform, the degenerate exponential function, the degenerate sine and cosine functions, the degenerate hyperbolic sine and hyperbolic cosine functions and the degenerate Laplace transform.

Definition 2.1. The Elzaki transform [3, (2), p. 57]: For a function $f(t)$ of exponential order belonging to the set A defined by

$$A = \left\{ f(t) : \exists M, k_1, k_2 > 0, |f(t)| < M e^{\frac{|t|}{k_j}}, \text{ if } t \in (-1)^j \times [0, \infty), j = 1, 2, \right\}$$

where the constant M is finite and k_1 and k_2 may be finite or infinite, the Elzaki transform of $f(t)$ is defined by

$$\mathcal{E}[f(t)] = s \int_0^\infty f(t) e^{-\frac{t}{s}} dt = T(s), t \geq 0,$$

which may also be rewritten as

$$\mathcal{E}[f(t)] = s^2 \int_0^\infty f(st) e^{-t} dt, t \geq 0.$$

Thus,

$$\mathcal{E}[f(t)] = s^2 \int_0^\infty f(st) e^{-t} dt = s \int_0^\infty f(t) e^{-\frac{t}{s}} dt = T(s), t \geq 0.$$

Definition 2.2. The degenerate exponential function [12, (1.3), p. 241]: The degenerate exponential function denoted by e_λ^t is a function of two variables $\lambda \in (0, \infty)$ and $t \in R$ defined by

$$e_\lambda^t = (1 + \lambda t)^{\frac{1}{\lambda}}.$$

It may be noted that,

$$\lim_{\lambda \to 0+} e_\lambda^t = \lim_{\lambda \to 0+} (1 + \lambda t)^{\frac{1}{\lambda}} = \sum_{n=0}^\infty \frac{t^n}{n!} = e^t.$$

Definition 2.3. The degenerate Euler formula [12, (1.9), p. 242]: The degenerate Euler formula is defined by the relation

$$e_\lambda^{it} = \lim_{\lambda \to 0+} (1 + \lambda t)^{\frac{i}{\lambda}} = \cos_\lambda(t) + i \sin_\lambda(t).$$

It can be noted that,

$$\lim_{\lambda \to 0+} e_\lambda^{it} = \lim_{\lambda \to 0+} (1 + \lambda t)^{\frac{i}{\lambda}} = e^{it} = \cos t + \sin t.$$

Definition 2.4. The degenerate cosine and the degenerate sine functions [12, (1.12), p. 242]: The degenerate cosine and the degenerate sine functions are defined by the relations

$$\cos_\lambda(t) = \frac{e_\lambda^{it} + e_\lambda^{-it}}{2} \quad \text{and} \quad \sin_\lambda(t) = \frac{e_\lambda^{it} - e_\lambda^{-it}}{2i}.$$

Here, it may be easily observed that

$$\lim_{\lambda \to 0+} \cos_\lambda(t) = \cos t \quad \text{and} \quad \lim_{\lambda \to 0+} \sin_\lambda(t) = \sin t.$$

Definition 2.5. The degenerate cosine and the degenerate sine functions [12, (3.10), (3.11) p. 245]: The degenerate hyperbolic cosine and the degenerate hyperboli sine functions are defined by the relations

$$\cosh_\lambda(at) = \frac{1}{2} \left((1 + \lambda t)^{\frac{a}{\lambda}} + (1 + \lambda t)^{-\frac{a}{\lambda}} \right), \quad \sinh_\lambda(at) = \frac{1}{2} \left((1 + \lambda t)^{\frac{a}{\lambda}} - (1 + \lambda t)^{-\frac{a}{\lambda}} \right).$$

Definition 2.6. The degenerate Laplace transform [12, (3.1) p. 244]: Let $\lambda \in (0, \infty)$ and let $f(t)$ be a function defined for $t \geq 0$, then the integral

$$\mathcal{L}_\lambda[f(t)] = \int_0^\infty (1 + \lambda t)^{\frac{-s}{\lambda}} f(t) dt,$$

is said to be the degenerate Laplace transform of f if the integral converges, it is also denoted by $\mathcal{L}_\lambda[f(t)] = F_\lambda(s)$.

3   The degenerate Elzaki transform

For $\lambda \in (0, \infty)$ and for a function $f(t)$ defined for $t \geq 0$ we define the *degenerate Elzaki transform* of $f(t)$ by the relation

$$\mathcal{E}_\lambda[f(t)] = T_\lambda(s) = s^2 \int_0^\infty (1 + \lambda t)^{\frac{-1}{\lambda}} f(st) dt. \tag{3.1}$$

Let $w = st$, then the equation (3.1) becomes

$$\mathcal{E}_\lambda[f(t)] = s^2 \int_0^\infty e_\lambda^{-t} f(st) dt$$

$$= s^2 \int_0^\infty e_\lambda^{\frac{-w}{s}} f(w) \frac{dw}{s}$$

$$T_\lambda(s) = s \int_0^\infty e_\lambda^{\frac{-w}{s}} f(w) dw = s \int_0^\infty e_\lambda^{\frac{-t}{s}} f(t) dt.$$

Now we give below the duality relation between the degenerate Elzaki transform and the degenerate Laplace transform.

3.1   Duality relation between the degenerate Elzaki transform and the degenerate Laplace transform

Let $T_\lambda(s)$ be the degenerate Elzaki transform of $f(t)$ and $F_\lambda(s)$ be the degenerate Laplace transform of $f(t)$, i.e., $\mathcal{E}_\lambda(f(t)) = T_\lambda(s)$ and $\mathcal{L}_\lambda(f(t) = F_\lambda(s)$. Then from (3.1) follows that,

$$\mathcal{E}_\lambda[f(t)] = s \int_0^\infty (1 + \lambda t)^{\frac{-1}{\lambda s}} f(t) dt = T_\lambda(s). \tag{3.2}$$

Now, from the Definition 2.6, we have

$$\mathcal{L}_\lambda[f(t)] = \int_0^\infty (1 + \lambda t)^{\frac{-s}{\lambda}} f(t) dt = F_\lambda(s).$$

This implies that

$$F_\lambda \left(\frac{1}{s} \right) = \int_0^\infty (1 + \lambda t)^{\frac{-1}{\lambda s}} f(t) dt. \tag{3.3}$$

Using (3.3) in (3.2) we get

$$\mathcal{E}_\lambda[f(t)] = T_\lambda(s) = s F_\lambda \left(\frac{1}{s} \right). \tag{3.4}$$

Now, replace s by $\frac{1}{s}$ in (3.4) we have the following desired duality relation between the degenerate Elzaki transform and the degenerate Laplace transform

$$T_\lambda \left(\frac{1}{s} \right) = \frac{1}{s} F_\lambda(s)$$

$$F_\lambda(s) = s T_\lambda \left(\frac{1}{s} \right). \tag{3.5}$$

4   Properties of the degenerate Elzaki transform

In this section we establish some properties of the degenerate Elzaki transform.

Theorem 4.1. *For any constant real numbers α and β we have the following linearity property of the degenerate Elzaki transform:*

$$\mathcal{E}_\lambda[\alpha f(t) + \beta g(t)] = \alpha \mathcal{E}_\lambda[f(t)] + \beta \mathcal{E}_\lambda[g(t)].$$

Proof. The proof is self evident.   □

Theorem 4.2. *The degenerate Elzaki transforms of the degenerate cosine function and the degenerate sine function are given by*

$$\mathcal{E}_\lambda[\cos_\lambda(at)] = \frac{s^2(1 - \lambda s)}{(1 - \lambda s)^2 + (as)^2} \quad \text{and} \quad \mathcal{E}_\lambda[\sin_\lambda(at)] = \frac{s^3 a}{(1 - \lambda s)^2 + (as)^2}.$$

Proof. We apply (3.4) to the following results proved by Kim and Kim [12, (3.8), p. 244 and (3.9) p. 245]

$$\mathcal{L}_\lambda[\cos_\lambda(at)] = \frac{s - \lambda}{(s - \lambda)^2 + a^2} \quad \text{and} \quad \mathcal{L}_\lambda[\sin_\lambda(at)] = \frac{a}{(s - \lambda)^2 + a^2},$$

by first taking $\mathcal{L}_\lambda[\cos_\lambda(at)] = F_\lambda(s)$ we have

$$\mathcal{E}_\lambda[\cos_\lambda(at)] = s\frac{\frac{1}{s} - \lambda}{(\frac{1}{s} - \lambda)^2 + a^2},$$
$$= \frac{s^2(1 - \lambda s)}{(1 - \lambda s)^2 + (as)^2},$$

and similarly then by taking $\mathcal{L}_\lambda[\sin_\lambda(at)] = F_\lambda(s)$ we get

$$\mathcal{E}_\lambda[\sin_\lambda(at)] = s\frac{a}{(\frac{1}{s} - \lambda)^2 + (a)^2},$$
$$= \frac{as^3}{(1 - \lambda s)^2 + (as)^2}.$$

$\square$

Theorem 4.3. *The degenerate Elzaki transforms of the degenerate hyperbolic functions are given by*

$$\mathcal{E}_\lambda[\cosh_\lambda(at)] = s^2\frac{1 - \lambda s}{(1 - \lambda s)^2 - (as)^2} \quad \text{and} \quad \mathcal{E}_\lambda[\sinh_\lambda(at)] = \frac{as^3}{(1 - \lambda s)^2 - (as)^2}.$$

Proof. Using (3.4) in the following results proved by Kim and Kim [12, (3.14), (3.15) p. 245]

$$\mathcal{L}_\lambda[\cosh_\lambda(at)] = \frac{s - \lambda}{(s - \lambda)^2 - a^2} \quad \text{and} \quad \mathcal{L}_\lambda[\sinh_\lambda(at)] = \frac{a}{(s - \lambda)^2 - a^2},$$

by first taking $\mathcal{L}_\lambda[\cosh_\lambda(at)] = F_\lambda(s)$ we have

$$\mathcal{E}_\lambda[\cosh_\lambda(at)] = s\frac{\frac{1}{s} - \lambda}{(\frac{1}{s} - \lambda)^2 - a^2},$$
$$= \frac{s^2(1 - \lambda s)}{(1 - \lambda s)^2 - (as)^2},$$

and similarly then by taking $\mathcal{L}_\lambda[\sinh_\lambda(at)] = F_\lambda(s)$ we get

$$\mathcal{E}_\lambda[\sinh_\lambda(at)] = s\frac{a}{(\frac{1}{s} - \lambda)^2 - (a)^2},$$
$$= \frac{as^3}{(1 - \lambda s)^2 - (as)^2}.$$

$\square$

Theorem 4.4. *For $n \in \mathbb{N}$ and $s > (n + 1)\lambda$,*

$$\mathcal{E}_\lambda(t^n) = \frac{n! s^{n+2}}{(1 - \lambda s)(1 - 2\lambda s) \dots (1 - n\lambda s)(1 - (n + 1)\lambda s)}.$$

Proof. Using the following result of (3.4)

$$T_\lambda(s) = sF_\lambda\left(\frac{1}{s}\right)$$

in the following result proven by Kim and Kim [12, Theorem 3.2, p. 246] for $n \in \mathbb{N}$ and $s > (n + 1)\lambda$

$$\mathcal{L}_\lambda(t^n) = \frac{n!}{(s - \lambda)(s - 2\lambda) \dots (s - n\lambda)(s - (n + 1)\lambda)}$$

by taking in the present case $F_\lambda(s) = \mathcal{L}_\lambda(t^n)$ we get

$$\mathcal{E}_\lambda(t^n) = s \frac{n!}{(\frac{1}{s} - \lambda)(\frac{1}{s} - 2\lambda)\dots(\frac{1}{s} - n\lambda)(\frac{1}{s} - (n+1)\lambda)}$$

$$= \frac{sn!}{\frac{1}{s^{n+1}}(1 - \lambda s)(1 - 2\lambda s)\dots(1 - n\lambda s)(1 - (n+1)\lambda s)},$$

or,

$$\mathcal{E}_\lambda(t^n) = \frac{n! s^{n+2}}{(1 - \lambda s)(1 - 2\lambda s)\dots(1 - n\lambda s)(1 - (n+1)\lambda s)}.$$

$\square$

Theorem 4.5. *If $f, f^{(1)}, \dots, f^{(n-1)}$ are continuous on $(0, \infty)$ and are of degenerate exponential order and if $f^{(n)}(t)$ is piecewise continuous on $(0, \infty)$, then*

$$\mathcal{E}_\lambda[f^{(n)}(t)] = \frac{1}{s}\left(\frac{1}{s} + \lambda\right)\dots\left(\frac{1}{s} + (n-1)\lambda\right)\mathcal{E}_\lambda[(1 + \lambda t)^{-n} f(t)]$$

$$- s\sum_{i=0}^{\infty} f^{(i)}(0)\left[\prod_{l=1}^{n-i-1}\left(\frac{1}{s} + (l-1)\lambda\right)\right],$$

where $f^{(n)}(t) = \left(\frac{d}{dt}\right)^n f(t)$.

Proof. We first prove this result by the method of induction. Applying directly the definition of the degenerate Elzaki transform to find the degenerate Elzaki transform of the function $f^{(1)}(t)$ we get

$$\mathcal{E}_\lambda\left(f^{(1)}(t)\right) = s\int_0^{\infty}(1 + \lambda t)^{-\frac{1}{s\lambda}} f^{(1)}(t)\, dt,$$

which on integration by parts gives

$$\mathcal{E}_\lambda\left(f^{(1)}(t)\right) = s\left[(1 + \lambda t)^{-\frac{1}{s\lambda}} f(t)\right]_{t=0}^{\infty} - s \times \frac{1}{s}\int_0^{\infty}(1 + \lambda t)^{-\frac{1}{s\lambda} - 1} f(t)\, dt.$$

A simple evaluation of the above expression, noting that $\lim_{t\to\infty}(1 + \lambda t)^{-\frac{1}{s\lambda}} f(t) = 0$, gives

$$\mathcal{E}_\lambda\left(f^{(1)}(t)\right) = -sf(0) + \frac{1}{s}\mathcal{E}_\lambda\left((1 + \lambda t)^{-1} f(t)\right).$$

If we let $g(t) = f^{(1)}(t)$ then

$$\mathcal{E}_\lambda\left(f^{(2)}(t)\right) = s\int_0^{\infty}(1 + \lambda t)^{-\frac{1}{s\lambda}} f^{(2)}(t)\, dt = s\int_0^{\infty}(1 + \lambda t)^{-\frac{1}{s\lambda}} g^{(1)}(t)\, dt = \mathcal{E}_\lambda\left(g^{(1)}(t)\right),$$

which on the application of the last result deduced for the degenerate Elzaki transform of the first derivative of a function yields,

$$\mathcal{E}_\lambda\left(f^{(2)}(t)\right) = -sg(0) + \frac{1}{s}\mathcal{E}_\lambda\left((1 + \lambda t)^{-1} g(t)\right) = -sf^{(1)}(0) + \frac{1}{s}\mathcal{E}_\lambda\left((1 + \lambda t)^{-1} f^{(1)}(t)\right)$$

$$= -sf^{(1)}(0) + \frac{1}{s} \times s\int_0^{\infty}(1 + \lambda t)^{-\frac{1}{s\lambda} - 1} f^{(1)}(t)\, dt.$$

Evaluating the second integral on the right hand side of the last equation by parts we can write that

$$\mathcal{E}_\lambda\left(f^{(2)}(t)\right) = -sf^{(1)}(0) + \left[(1 + \lambda t)^{-\frac{1}{s\lambda} - 1} f(t)\right]_{t=0}^{\infty} + \lambda \times \left(\frac{1}{\lambda s} + 1\right)\int_0^{\infty}(1 + \lambda t)^{-\frac{1}{s\lambda} - 2} f(t)\, dt,$$

which, on noting that $\lim_{t\to\infty}(1 + \lambda t)^{-\frac{1}{s\lambda} - 1} f(t) = 0$, simplifies to

$$\mathcal{E}_\lambda\left(f^{(2)}(t)\right) = -sf^{(1)}(0) - f(0) + \frac{1}{s}\left(\frac{1}{s} + \lambda\right)\mathcal{E}_\lambda\left((1 + \lambda t)^{-2} f(t)\right).$$

Proceeding ahead similarly after n-steps we can get the desired result.

$\square$

Alternative Proof of Theorem 4.3. We now prove Theorem 4.3 by making use of the duality relation (3.4) between the degenerate Elzaki transform and the degenerate Laplace transform. Kim and Kim [12, (3.20), p. 246] have shown that

$$\mathcal{L}_\lambda \left(f^{(1)}(t) \right) = -f(0) + s\mathcal{L}_\lambda \left((1+\lambda t)^{-1} f(t) \right) = -f(0) + s \int_0^\infty (1+\lambda t)^{-\frac{s}{\lambda}-1} f(t)\, dt = F_\lambda(s), \quad \text{(say)},$$

to which a simple application of (3.4) gives

$$\mathcal{E}_\lambda \left(f^{(1)}(t) \right) = sF_\lambda \left(\frac{1}{s} \right) = s \left[-f(0) + \frac{1}{s} \int_0^\infty (1+\lambda t)^{-\frac{1}{s\lambda}-1} f(t)\, dt \right]$$

$$= -sf(0) + \frac{1}{s}\mathcal{E}_\lambda \left((1+\lambda t)^{-1} f(t) \right).$$

Kim and Kim [12, (3.22), p. 246] have further shown that

$$\mathcal{L}_\lambda \left(f^{(2)}(t) \right) = -f^{(1)}(0) - sf(0) + s(s+\lambda)\mathcal{L}_\lambda \left((1+\lambda t)^{-2} f(t) \right)$$

$$= -f^{(1)}(0) - sf(0) + s(s+\lambda) \int_0^\infty (1+\lambda t)^{-\frac{s}{\lambda}-2} f(t)\, dt = F_\lambda(s), \quad \text{(say)},$$

to which an application of (3.4) yields that

$$\mathcal{E}_\lambda \left(f^{(2)}(t) \right) = sF_\lambda \left(\frac{1}{s} \right) = s \left[-f^{(1)}(0) - \frac{1}{s} f(0) + \frac{1}{s} \left(\frac{1}{s} + \lambda \right) \int_0^\infty (1+\lambda t)^{-\frac{1}{s\lambda}-2} f(t)\, dt \right]$$

$$= -sf^{(1)}(0) - f(0) + \frac{1}{s} \left(\frac{1}{s} + \lambda \right) \mathcal{E}_\lambda \left((1+\lambda t)^{-2} f(t) \right).$$

Finally, Kim and Kim [12, (3.23), p. 246] have shown that

$$\mathcal{L}_\lambda \left(f^{(n)}(t) \right) = s(s+\lambda)\ldots(s+(n-1)\lambda)\mathcal{L}_\lambda \left((1+\lambda t)^{-n} f(t) \right) - \sum_{i=0}^{n-1} f^{(i)}(0) \left(\prod_{l=1}^{n-i-1} (s+(l-1)\lambda) \right)$$

$$= s(s+\lambda)\ldots(s+(n-1)\lambda) \int_0^\infty (1+\lambda t)^{-\frac{s}{\lambda}-n} f(t)\, dt$$

$$- \sum_{i=0}^{n-1} f^{(i)}(0) \left(\prod_{l=1}^{n-i-1} (s+(l-1)\lambda) \right) = F_\lambda(s), \quad \text{(say)},$$

to which an application of (3.4) as illustrated above yields the desired result. $\square$

Theorem 4.6. The first translation theorem for the degenerate Elzaki transform:
If $\mathcal{E}_\lambda(f(t)) = T_\lambda(s)$ then

$$\mathcal{E}_\lambda \left(e_\lambda^{at} f(t) \right) = (1-as)T_\lambda \left(\frac{s}{1-as} \right), \text{ for } a \neq \frac{1}{s}.$$

Proof. From the definition of the degenerate Elzaki transform it follows that

$$\mathcal{E}_\lambda \left(e_\lambda^{at} f(t) \right) = s \int_0^\infty (1+\lambda t)^{-\frac{1}{\lambda s}} e_\lambda^{at} f(t)\, dt = s \int_0^\infty (1+\lambda t)^{-\frac{1}{\lambda s}} (1+\lambda t)^{\frac{a}{\lambda}} f(t)\, dt$$

$$= (1-as) \cdot \left(\frac{s}{1-as} \right) \int_0^\infty (1+\lambda t)^{-\frac{(1-as)}{\lambda s}} f(t)\, dt = (1-as) T_\lambda \left(\frac{s}{1-as} \right),$$

where, $a \neq \frac{1}{s}$. $\square$

Theorem 4.7. The change of scale property for the degenerate Elzaki transform:
If $\mathcal{E}_\lambda(f(t)) = T_\lambda(s)$ then

$$\mathcal{E}_\lambda(f(at)) = \frac{1}{a^2} T_{\frac{\lambda}{a}}(as), \text{ for } a \neq 0.$$

Proof. Utilizing the definition of the degenerate Elzaki transform we see that

$$\mathcal{E}_\lambda\left(f(at)\right) = s\int_0^\infty (1+\lambda t)^{-\frac{1}{\lambda s}} f(at)dt,$$

in which the substitution $u = at$ with $du = adt$ leads us to

$$\mathcal{E}_\lambda\left(f(at)\right) = \frac{s}{a}\int_0^\infty \left(1+\frac{\lambda}{a}u\right)^{-\frac{1}{\lambda s}} f(u)du = \frac{1}{a^2}\cdot(as)\int_0^\infty \left(1+\frac{\lambda}{a}u\right)^{-\frac{1}{\left(\frac{\lambda}{a}\right)\cdot as}} f(u)du$$

$$= \frac{1}{a^2}T_{\frac{\lambda}{a}}\left(as\right), \quad a\neq 0.$$

$\square$

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World Scientific News

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Fabrication of Dye Sensitized Solar Cell Based on Natural Photosensitizers

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ABSTRACT

Dye Sensitized solar cells were fabricated using with natural extracts and TiO_2 is used as a semiconducting layer. The layer of nanocrytalline titanium dioxide was deposited on conductive side of the transparent Fluorine doped Tin Oxide (FTO) glass plate and the other side of the plate is coated with graphite. Voltage and Current values are measured for natural dyes coated FTO plate and I-V characteristic curves of all fabricated cells were drawn and analyzed. The highest power conversion efficiencies of Blueberry (0.79872%) and Beetroot (0.745813 %.) dyes were achieved among 10 dyes. The functional groups of Beetroot and Turmeric natural dyes were confirmed under FTIR spectroscopy. The ease and cost efficiency of the overall fabrication process, extensive availability of these fruits/juices render them novel and low-cost candidates for Solar cell applications.

Keywords: Natural Dyes, nanocrystalline materials, nanocrytalline titanium dioxide, Solar cell, FTIR spectroscopy, Efficiency, Functional

1. INTRODUCTION

The dye sensitized solar cell (DSSC) provides a technically and economically credible alternative concept to present day p–n junction photovoltaic devices. The dye molecules are quite small so in order to capture amount of the incoming light the layer of dye molecules needs

to be made fairly thick, much thicker than the molecules themselves. It shows excellent absorption in the visible region (400 nm to 700 nm), Adsorb strongly on the surface of the semiconductor, has a high extinction coefficient and be stable in its oxidized form allowing it to be reduced by an electrolyte.

Interest in the dye-sensitized solar cells increased with this development. Previous studies [1-5] show that an ideal solar cell material should have the foll0owing features such as band range within of 1 to 1.7 eV, Direct band to be speed, Easily producible, does not contain toxic substances, Good photovoltaic conversion efficiency, High absorption coefficient and Stability. Dye Sensitized Solar Cells It is a low-cost solar cell belonging to the group of thin film solar cells. It is based on a semiconductor formed between a photo-sensitized cathode (TiO_2) and an electrolyte, a photo electrochemical system. The photoelectrons are provided from a separate photosensitive dye which contains acid functional group for anchoring on TiO_2 and Charge separation occurs at the surfaces between the dye, semiconductor and electrolyte [6-10].

A DSSC is generally composed of a photoactive (PV) semiconductor, working electrode of titanium dioxide, and a counter electrode. The dye used in DSSC acts as a photosensitizer allowing solar energy to be converted to electrical energy. The type of dye used in a solar cell is one of the most crucial components influencing solar cell performance as the sensitizer is what determines the photo response of the DSSC. The dye is contained in the photo anodes that are responsible for better absorbance and stronger electron excitation properties, conclusively granting more efficient solar cell [11-15].

When incident photons on a DSSC are being absorbed by the photo-anodes, electrons are excited from the ground state to the excited state and subsequently transferred to the conduction band of the TiO_2. This process oxidizes the photo-anodes causing the electrons to travel through the electrolyte to the cathode of the cell and returns back to the anode via the circuit. This reoccurring process of moving charges generates electricity.

Several studies have been reported [16-18] in the past about the optical properties of dyes such as Anthocyanin and Chlorophyll. Anthocyanin's are brightly colored pigments found in plants and may have different colors depending on the pH. Synthetic chlorophyll and anthocyanin have been developed for the production of solar cells. Synthesis of these dyes could be controlled to obtain concentrated and minute dye particles vital for obtaining higher photoelectric conversion efficiency of solar cells. The cost of production of these dyes is however very high. Therefore someone needs to prove and discover a potential natural source of a dye with the best photoelectric conversion efficiency to improve DSSC productivity. Since natural dyes are cheaper to obtain, it would be more economical to mass produce DSSC that could be used in appliances as portable chargers or integrated into building facades. The objective of this work was to analyze and determine the most efficient natural dye and to find a consistent and reliable method for producing the cells.

2. EXPERIMENTAL

2. 1. Materials and Methods

Materials used for fabrication of DSSC

Materials used for coating the FTO plate: TiO_2 powder, ethanol, iodine electrolyte, graphite carbon pencil and distilled water were used to coat the FTO (Fluorine tin oxide coated glasses).

Extraction of dyes: For the dye, beetroot, carrot, turmeric powder, chilly powder, blueberries, tamarind, coffee powder, mint juice, orange and tomato were used. The photograph for prepared dyes and coated plates are is shown in the figure 1.

Testing of Conductive side: The substrates must be coated in the opposite of the conductive side. In order to check the conductive side UV light was used and multimeter was used to check the conductive side by placing it at the sound area.

2. 2. Methods used for the preparation of DSSC

Experimental steps were done in three parts, which are the preparation of the cathode electrode (TiO$_2$ electrode), preparation of the anode electrode (carbon counter electrode & Preparation of Iodine electrolyte) and the preparation of the dye solution.

Preparation of TiO$_2$ electrode

The TiO$_2$ films were made by spreading TiO$_2$ pastes on the fluorine tin oxide conducting glass (FTO) by using the glass rod. TiO$_2$ paste was prepared by mixing the TiO$_2$ powder with ethanol. Extensive stirring were proceeded to ensure complete dispersion of TiO$_2$ powder and to facilitate the spreading of the colloid on FTO glass. Droplets of each paste were placed onto the FTO glass. Cello tapes were placed on the edges of FTO glass to spread the pastes for about 10 seconds. Then, the TiO$_2$ was sintered at the burner for 10 minutes. The resulted electrode was then cooled down to room temperature. Thickness of the TiO$_2$ film was controlled by multiple coating processes in which the coated substrates were subjected repeatedly.

Preparation of Counter electrode

To prepare the counter electrode, the FTO glass was wiped with ethanol. Then, the FTO glass surface was colored by using pencil using graphite. After that, the surface was checked to ensure that there was no space that the carbon did not cover. In the preparation of liquid electrolyte, 0.127 gm of Iodine and 0.83 gm of Potassium Iodide were added into the beaker containing 10 ml of Ethylene Glycol. The mixture was mixed until there was no grain of Iodine and Potassium Iodide by using glass rod.

2. 3. Preparation of dyes

For the preparation of blueberry dye, 10 blueberries were taken and washed with distilled water. Washed blueberries grinded well and we mixed it with ethanol. Ethanol mixed blueberry mixture was taken in a tube and placed it in a centrifuge. Solid particles settled at the bottom and liquid on the top of the tube is used as a blueberry dye. No water was added into the solution. Cathode electrode was then immersed in the dye solution for more than six hours. After that, the surface of the TiO$_2$ photo electrode was cleaned by using the ethanol to ensure that there were no blueberry dye remained at the edge of the FTO surface.

2. 4. Assembling of DSSC

Step 1: The cathode electrode and the anode electrode were put together, overlapping each other, and a space at the end of each electrode was made.

Step 2: Three drops of iodide solution were added at the end of the electrode and the solutions were spread over the entire electrode. Then, the remaining iodide solution was wiped off using cotton swab soaked with acetone (Figure 1).
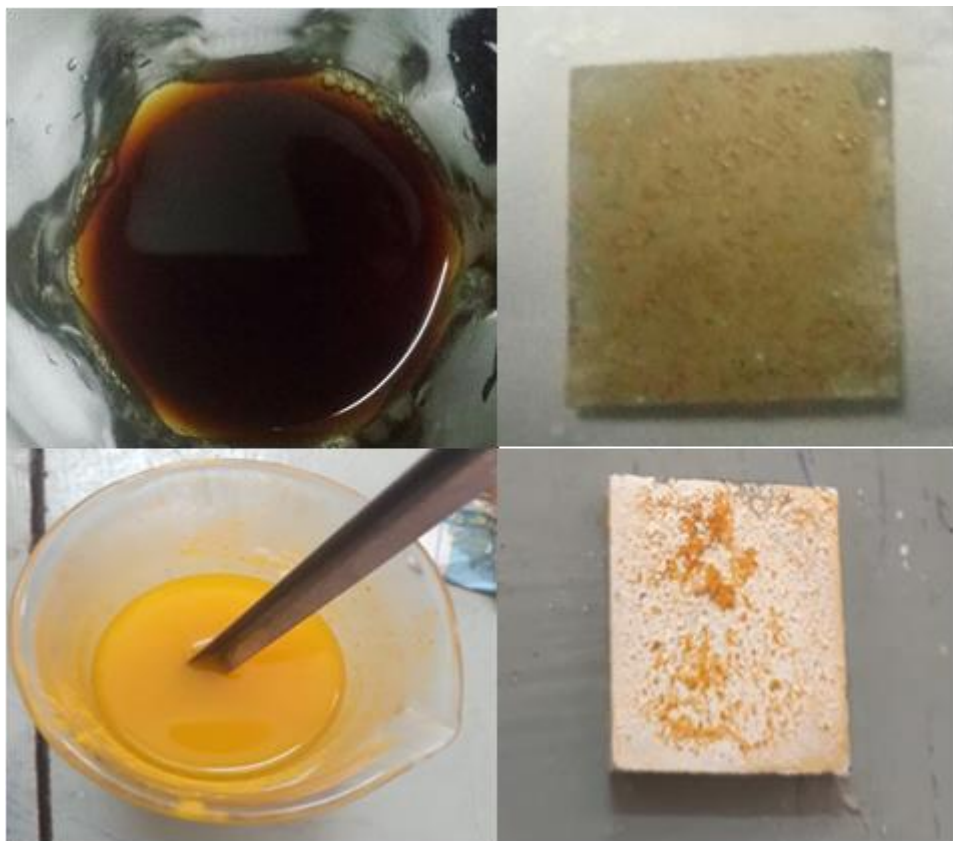
Figure 1. Photograph of Coffee & Turmeric powder dyes and dye soaked plates

Step 3: Next, electrodes were fastening using the binder clip after that, it was tested with the multi meter and corresponding readings were taken for voltage, capacitance and current. The experiment was conducted under sunlight. The same procedure was done for the other dyes. The photograph for fabrication of DSSC is shown in the Figure 2.

3. RESULTS AND DISCUSSION

3. 1. Performance of DSSC's using Natural Dyes

The current, voltage and capacitance values are measured for Coffee, Turmeric, Chili powder, Orange, Carrot, Tamarind, Mint, Tomato and Beetroot dyes coated DSSC's. Figure 3 shows the volathe and capacitance measurement for carrot dye coated DSSC. The measured value of current, voltage and capacitance for ten natural dyes are tabulated in the Table 1 and the measured values show that the voltage readings are less than the capacitance values as predicted for all the natural dyes. The graph is drawn between the Voltage (V) and Current (micro amp) values measured for the ten dyes and shown in the Figure 4.
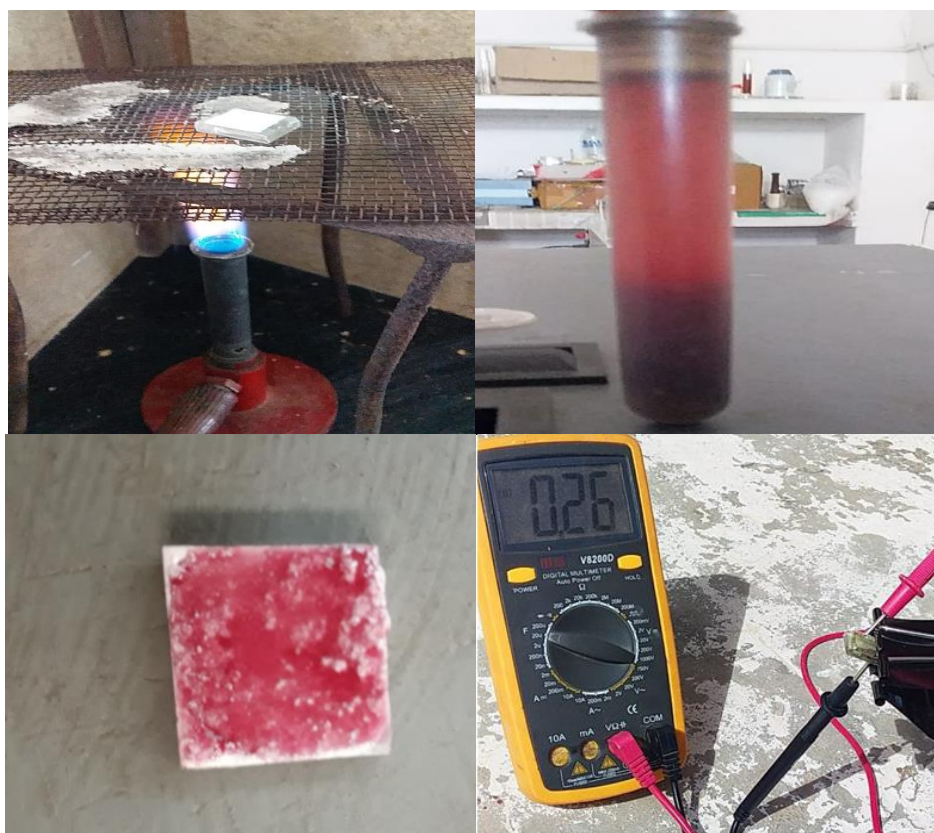
Figure 2. Photograph of Dye Sensitized Solar Cell Fabrication

Figure 3. Voltage and Capacitance readings of carrot dye
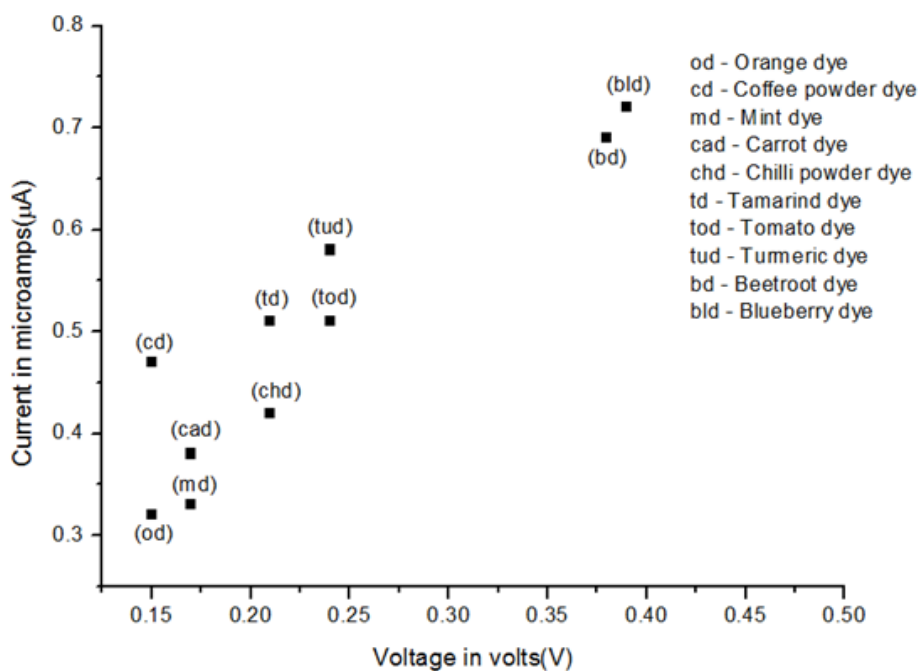
Figure 4. I-V Characteristic curve of DSSC based on natural dyes

Table 1. Specification of prepared DSSC's with different natural dyes

Dyes	Voltage readings in (Volts)	Current readings in (amps)	Capacitance readings in (Farad)	P₀ (Maximum output voltage)	Pi (Maximum output voltage)	Efficiency (%)
Orange	0.15	0.32	0.21	0.000256	0.1875	0.13653
Mint	0.17	0.33	0.38	0.0002992	0.1875	0.159573
Carrot	0.17	0.38	0.26	0.00034453	0.1875	0.1837493
Blueberry	0.39	0.72	1.42	0.0014976	0.1875	0.79872
Coffee	0.15	0.47	0.27	0.000376	0.1875	0.20053
Chilly	0.21	0.49	0.71	0.0004704	0.1875	0.25088
Tamarind	0.21	0.51	0.52	0.0005712	0.1875	0.30464
Tomato	0.24	0.51	0.28	0.0006528	0.1875	0.34816
Turmeric	0.24	0.58	0.62	0.0007424	0.1875	0.395946
Beetroot	0.38	0.69	1.45	0.0013984	0.1875	0.745813

3. 2. Thickness of the FTO plate:

The thickness of TiO_2 coated FTO plate is calculated from the formula

$$t = \frac{m}{Ad}$$

where: t- Thickness, m- mass of the film (After coating-before coating), A-Area of the FTO plate, d- Density (TiO_2 powder), t- After coating-Before coating the film/Area*Density

t = 1.755-1.5/0.0001875*4.23

t = 0.00003215 mm

The photocurrent generated by the solar cell is directly proportional to the amount of the dye absorbed on TiO_2 film. This explains that more dye molecules are attracted to the increased surface of TiO_2. Then it can generate more electrons and improve the electron transport. The open circuit is almost the same and current density slightly varies according to the different dyes.

3. 3. Solar conversion efficiency measurement:

The solar conversion efficiency (η) of DSSC's can be estimated using the efficiency formula:

$$\eta = \frac{P_0}{Pi} \times 100\%$$

where: Maximum possible input Pi=1000 000 mW/m^2* cell active area (m^2), Maximum possible output P_o = V*I/A, V = Voltage reading in volts (V), I = Current reading in amps (I), Area of the FTO plate = l×b = 1.25×1.50 = 1.875 cm.

The efficiency calculation of Blueberry dye coated DSSC is given below

1) Coffee dye efficiency:

η = P_o /Pi×100%
Pi = 1000 000×10^{-3}×0.0001875
= 0.1875 w/m^2
P_o = 0.15×0.47×10^{-6}/0.0001875
= 0.000376 w/m^2
= 0.000376/0.1875×100%
η = 0.20053%

2) Blueberry dye efficiency:

η = P_o /Pi×100%
Pi = 1000 000×10^{-3}×0.0001875
= 0.1875 w/m^2
P_o = 0.39×0.72×10^{-6}/0.0001875
= 0.0014976 w/m^2
= 0.0014976/0.1875×100%
η = 0.79872%

3) Orange dye efficiency:

η = P_o /Pi×100%
Pi = 1000 000×10^{-3}×0.0001875
= 0.1875 w/m^2

$P_o = 0.15 \times 0.32 \times 10^{-6}/0.0001875$
$= 0.000256$ w/m^2
$= 0.000256/0.1875 \times 100\%$
$\eta = 0.13653\%$

4) Tomato dye efficiency:

$\eta = P_o /Pi \times 100\%$
$Pi = 1000\,000 \times 10^{-3} \times 0.0001875$
$= 0.1875$ w/m^2
$P_o = 0.24 \times 0.51 \times 10^{-6}/0.0001875$
$= 0.0006528$ w/m^2
$= 0.0006528/0.1875 \times 100\%$
$\eta = 0.34816\%$

5) Chilly dye efficiency:

$\eta = P_o /Pi \times 100\%$
$Pi = 1000\,000 \times 10^{-3} \times 0.0001875$
$= 0.1875$ w/m^2
$P_o = 0.21 \times 0.42 \times 10^{-6}/0.0001875$
$= 0.0004704$ w/m^2
$= 0.0004704/0.1875 \times 100\%$
$\eta = 0.25088\%$

6) Mint dye efficiency:

$\eta = P_o/Pi \times 100\%$
$Pi = 1000\,000 \times 10\text{-}3 \times 0.0001875$
$= 0.1875$ w/m^2
$P_o = 0.17 \times 0.33 \times 10^{-6}/0.0001875$
$= 0.0002992$ w/m^2
$= 0.0002992/0.1875 \times 100\%$
$\eta = 0.159573\%$

7) Beetroot dye efficiency:

$\eta = P_o/Pi \times 100\%$
$Pi = 1000\,000 \times 10^{-3} \times 0.0001875$
$= 0.1875$ w/m^2
$Po = 0.38 \times 0.69 \times 10^{-6}/0.0001875$
$= 0.0013984$ w/m^2
$= 0.0013984/0.1875 \times 100\%$
$\eta = 0.745813\%$

8) Carrot dye efficiency:

$\eta = P_o/Pi \times 100\%$
$Pi = 1000\,000 \times 10^{-3} \times 0.0001875$

$= 0.1875$ w/m^2
$P_o = 0.17 \times 0.38 \times 10^{-6}/0.0001875$
$= 0.00034453$ w/m^2
$= 0.00034453/0.18 \times 100\%$
$\eta = 0.1837493$

9) Tamarind dye efficiency:

$\eta = P_o/Pi \times 100\%$
$Pi = 1000\,000 \times 10^{-3} \times 0.0001875$
$= 0.1875$ w/m^2
$P_o = 0.21 \times 0.51 \times 10^{-6}/0.0001875$
$= 0.0005712$ w/m^2
$= 0.0005712/0.1875 \times 100\%$
$\eta = 0.30464\%$

10) Turmeric dye efficiency:

$\eta = P_o/Pi \times 100\%$
$Pi = 1000\,000 \times 10^{-3} \times 0.0001875$
$= 0.1875$ w/m^2
$P_o = 0.240.58 \times 10^{-6}/0.0001875$
$= 0.0007424$ w/m$^2 = 0.0007424/0.1875 \times 100\%$
$\eta = 0.395946\%$

Table 1 show the specification of prepared DSSC's with different natural dyes. DSSC solar cells have been assembled and Voltage, current (P_o, P_i) were tested. The DSSC's fabricated with TiO$_2$ using Orange, Mint, Carrot, Blueberry, Coffee, Chilly, Tamarind, Tomato, Turmeric, Beetroot extracted dye shows the efficiency value of 0.13653, 0.159573, 0.1837493, 0.79872, 0.20053, 0.25088, 0.30464, 0.34816, 0.395946, 0.745813% respectively.

Fabricated DSSC using orange dye shows less efficiency value (0.13653%) and DSSC using Blueberry shows higher efficiency value (0.79872%) because it contains a higher concentration of Betacyanin. It has been observed that the dark coloured Betacyanin leads to higher efficiency. DSSC with Beetroot, Turmeric (due to the concentration of Curcumin) Tomato & Tamarind dyes shows notable efficiency values. The lower current densities in this dye as compared to other dyes could be attributed to the additional impurities resulting from imprecise extraction processes [19].

3. 4. FTIR spectroscopy

The Beetroot & Turmeric dyes are extracted and characterized by FTIR spectroscopy and shown in Figure 5. The broad band obtained at 3398.92 cm^{-1} was allocated to the stretching vibration of Phenol compound of range (3200-3550 nm). The peak obtained at 2969.84 cm^{-1} represents the stretching vibration of Alkanes of range (2850-3000 nm). The observed peak at 1638.23 cm^{-1} denotes the stretching vibration of Alkenes of range (1630-1680 nm). The presence of Alkane, Alkene and Phenol compounds in the beetroot dye proved their interaction between TiO$_2$ and dye will contribute to the photoelectric efficiency of the device. For the Turmeric dye the observed broad band at 3397 cm^{-1} was allocated to the stretching vibration of

(N-H) bond (3300-3500). The peak obtained at 1740.44 cm^{-1} represents the stretching vibration of (C=C) bond (1500-1900) [20].
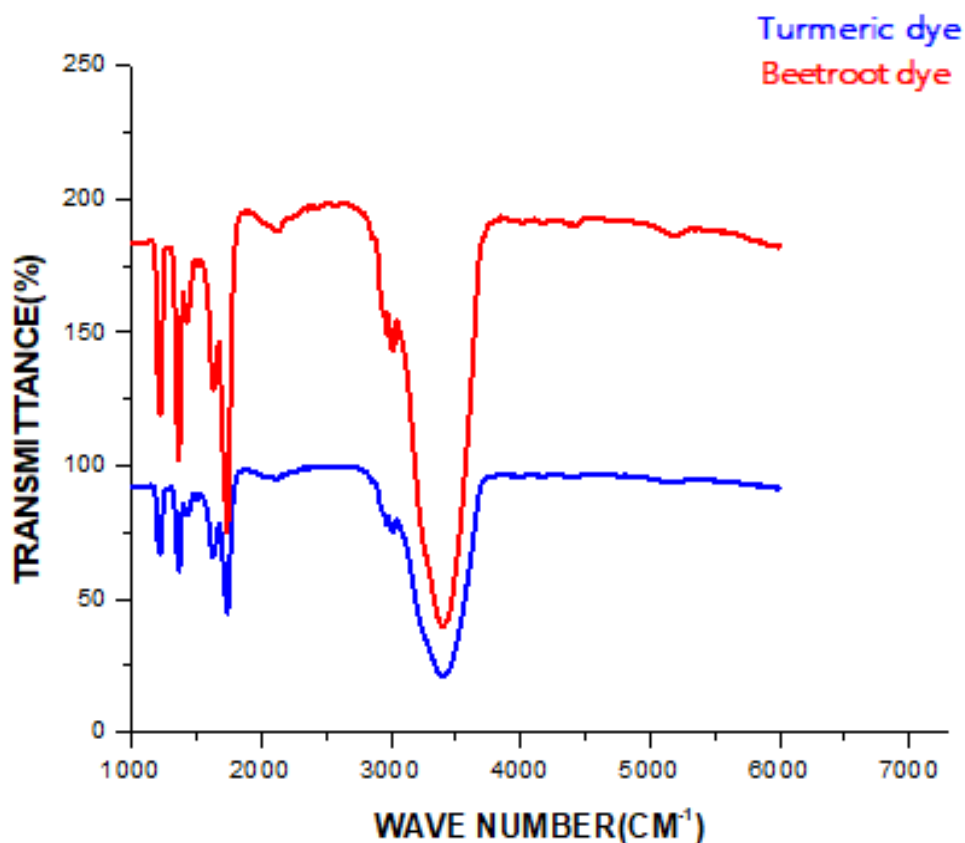
Figure 5. FTIR Spectra of Beetroot and Turmeric Dyes

4. CONCLUSIONS

In the present work, the utilization of naturally occurring dyes extracted from various commonly found fruits/vegetables (Orange, Mint, Carrot, Blueberry, Coffee, Chilly, Tamarind, Tomato, Turmeric and Beetroot) for the fabrication of DSSC's using the economical and efficient procedure. Dye extracted from Blueberry resulted in the DSSC's with the highest efficiencies. This is because darker color corresponds to increased light absorption leading to enhanced photocurrent densities.

The lower current densities in this dye as compared to other dyes could be attributed to the additional impurities resulting from imprecise extraction processes. The isolation and purification of the various isomers will address this issue and could potentially improve the power conversion efficiency. The simplicity and cost effectiveness of the overall fabrication process, widespread availability of these fruits/vegetables render them novel and inexpensive candidates for Solar cell application.

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World Scientific News

An International Scientific Journal

Green Synthesis of Copper Nanoparticles Using *Ocimum sanctum* L. (Tulsi) and *Piper nigrum* L. (Pepper Seed) for Pollution Free Environment

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ABSTRACT

Synthesis of nanoparticles using plant leaf extract is an eco-friendly, non-toxic and cost efficient approach in the field of nanotechnology. In this study, biosynthesis of stable copper nanoparticles were prepared by using *Ocimum sanctum* and *Piper nigrum* extract. These biosynthesized Cu nanoparticles were characterized with the help of X-Ray diffraction (XRD), Scanning Electron Microscopy (SEM) and Fourier transforms infrared spectroscopy (FTIR). The crystalline size of the Copper Nanoparticles prepared from Tulsi extract is little smaller than Copper nanoparticles prepared from Pepper extract. SEM images of Copper nanoparticles showed that the cluster formation, presence of smaller and larger grains. FTIR analysis revealed that the functional groups present in the Copper nanoparticles prepared from both Tulsi and Pepper extracts. Thus, this method can be used for rapid and ecofriendly biosynthesis of stable copper nanoparticles and can be used for catalytic agent, anti-microbial, anti-fungal, anti-biotic, nanosensor, super conducting material, solar cell applications.

*Keywords***:** *Ocimum sanctum*, Tulsi, *Piper nigrum*, Pepper, Diffraction, Green synthesis, Copper, Cu, Copper nano particles

1. INTRODUCTION

The skillful fabrication of nanoparticles has aspiring nanotechnology into one of today's most promising and prevalent fields of scientific research [1]. Potential future advancement requires the ability to prepare nanomaterials in a reproducible and controlled manner [2]. Currently, there is an aggregate attention to synthesize metallic copper nanocrystals not only for the expansion of synthetic advancement, but also for the assessment of their electrical, catalytic, sensing and surface properties [3-5]. Copper nanoparticles has been employed as heterogeneous catalysts for numerous environmental progressions, e.g., selective reduction in nitric oxide, oxidation of carbon monoxide and decomposition of nitrogen dioxide [6]. Metallic Cu nanoparticles are striking materials primarily because of their exceptional properties and low cost compared to other metallic nanomaterials such as gold and silver [7].

The ability to prepare nanomaterial with well-defined morphologies and sharp faces should enable the appraisal of their properties [8]. Synthesis of Cu nanoparticles is quiet challenging due to its high tendency for oxidation. It is extremely sensitive to air, and the oxide phases are thermodynamically more stable [9]. The high oxidation rate of Cu nanoparticles may limit their applications [10]. Oxidation of copper nanoparticles can be eliminated if the synthesis is conducted in the presence of CO or H_2. On the other hand, handling these gases is rather cumbersome, and use of such gases is avoided when possible [11].

Copper nanoparticles have been used in various fields, including agricultural, industrial engineering, wound dressings, gas sensors, catalytic process, high temperature superconductors, solar cells and technological fields [12-15]. Although the use of Nano science in agriculture has been predominantly theoretical up to now, effective antibacterial activities exhibited by Copper nanoparticles in agricultural research have increased development in the field of nanotechnology, leading to the establishment of intensively clean, cost-effective and efficient biosynthesis techniques of Copper Nano particles. Generally the Cu nanoparticles are synthesized from vapor deposition, electrochemical reduction, radiolysis reduction, thermal decomposition, chemical reduction of copper metal salt.

These methods involve high temperature, high pressure and hazardous chemicals, and some toxic chemicals absorbed on the surface of nanoparticles may cause adverse medical effects. Green synthesis of nanoparticles has several advantages over chemical and physical synthesis, a method using leaves extract. In addition, the plant-mediated synthesis is a rapid, flexible, and suitable process for large-scale production of nanoparticles. Among nanoparticles copper oxide nanoparticles have been used enormously due to their potent antibacterial activity.

In recent, green synthesis of Cu nanoparticles was achieved by using microorganisms, plant extract, *Ocimum sanctum* (local name Tulasi) is a traditional medicinal plant of India has a source of bio-reduct on and stabilizers. Recently *Ocimum sanctum* extracts have been used in the synthesis of silver nanoparticles and gold nanoparticles [16-18]. In the group of medicinal plants, the Piper nigrum possess excellent medicinal properties due to the presence of enormous phytochemicals.

The piperine is an alkaloid, majorly found in *Piper nigrum*, which belongs to the Piperaceae family that is massively cultivated at India and Sri Lanka [19, 20]. Owing to the presence of large amount of phytochemicals, the leaf and stem of Piper nigrum are taken into account for the synthesis of Copper nanoparticles. In the present study attempts were made to synthesis Copper nanoparticles by using *Ocimum sanctum* and *Piper nigrum* extracts.

2. EXPERIMENTAL MATERIALS AND METHODS

2. 1. Synthesis of Copper Nanoparticles Using Tulsi Extract

For the preparation of copper nanoparticles copper sulphate ($CuSO_4$) and tulsi leaf extract were used as precursors. The roughly washed leaves (100 gm) were cut and boiled with 100 ml of ionized water for 15 minutes using a heating mantle at 80 °C. The extract was filtered and stored in refrigerator. 10 ml of those tulsi leaf extract was added to 100 ml of the aqueous $CuSO_4 \cdot 5H_2O$ solution. Finally flask was then kept overnight at room temperature. The copper nanoparticles solution thus obtained was purified by repeated centrifugation at 12,000 rotations per minute for 15 minutes. Then the obtained Cu nanoparticles are dried using hot air oven at 80 °C for 3 hours.

2. 2. Synthesis of Copper Nanoparticles Using Pepper Seed Extract

For the synthesis of copper nanoparticles Copper Sulphate ($CuSO_4$) and Pepper Seed Extract were used as precursors. For the preparation of copper nanoparticles 1mm $CuSO_4 \cdot 5H_2O$ solution mixed with 20 ml of seed extract. Another set of same experiment conducted with a supply of microwave irradiation as an alternate energy source. The mixture was incubated for 3 hours at room temperature. The change in color indicating the formation of copper nanoparticles. The settled Copper nanoparticles were filtered and dried using a hot air oven. Figure 1 shows the Copper nanoparticles synthesized through chemical (green) and Microwave irradiation methods (Black).

Figure 1. Photograph of Copper Nanoparticles.

The XRD pattern of the Copper nanoparticles was analyzed by using a powder X-Ray diffractometer (Schimadzu model: XRD 6000 using CuKα ($\lambda = 0.154$ nm) radiation, with a diffraction angle between 0° to 80°. The surface morphology of the nanoparticles was recorded from Scanning Electron Microscopy (SEM). Functional group of synthesized Copper nanoparticles was observed from Fourier Transform Infra-Red spectroscopy (FTIR).

3. RESULTS AND DISCUSSION

3. 1. Structural analysis (XRD)

XRD pattern of synthesized Cu nanoparticles using a leaf extract of thulsi is shown in Figure 2. The XRD pattern reveals that a high crystallinity of Cu nanoparticles observed at different diffraction angles of 25.9°, 28.3° and 44.8°, which correspond to the characteristic face centered cubic (FCC) of copper lines indexed at (101), (200) and (220) respectively. The diffraction angle observed at 21.1° is related to the tulsi leaf extract medium. The estimated size of the nanoparticles is about 26.47 nm from Debye-Scherer Equation, which may indicate a high surface area, and surface area to volume ratio of the nanoparticles.
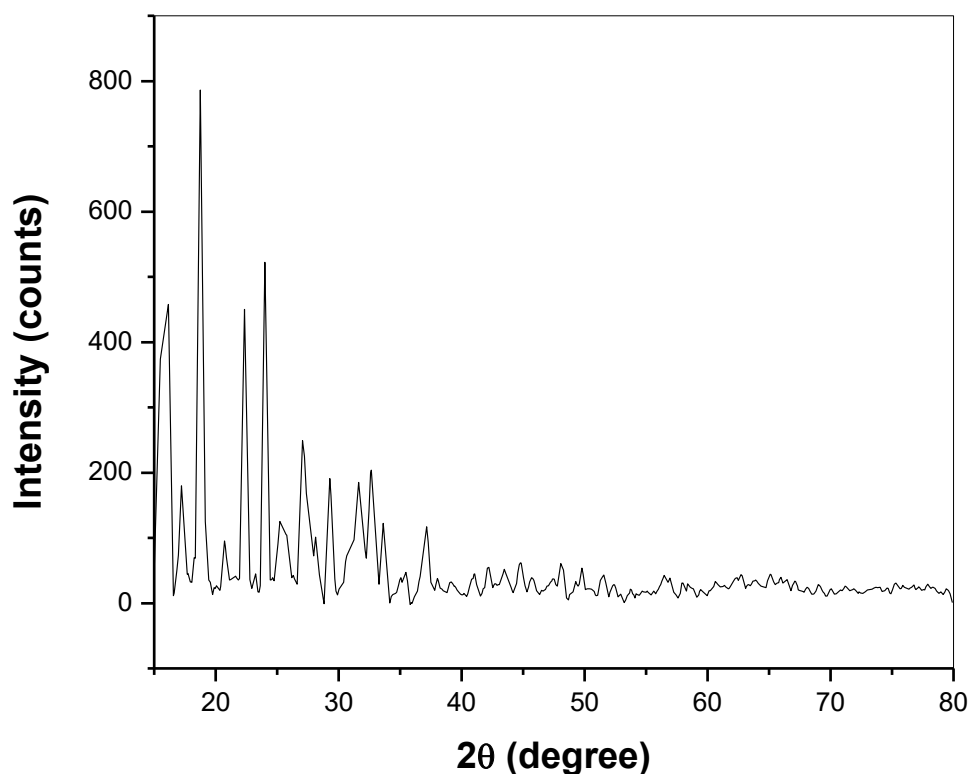
Figure 2. XRD Pattern of Cu nanoparticles from Tulsi extract

The Crystallite size of the nanoparticles is calculated from Debye Scherer formula which is written below:

$$D = 0.9 \, \lambda \, / \, (\beta \, \cos\theta)$$

where: K, known as Scherer's constant (shape factor), ranges from 0.9 to 1.0, is 1.5418 Å, which is the wavelength of the X-Ray radiation source, $\beta 1/2$ is the width of the XRD peak at half height and θ is the Bragg angle. XRD patterns obtained for the Cu NPs synthesized using pepper juice has been shown in Figure 3.

The presence of intense peak corresponds to (101), (200) and (220) indexed a crystalline copper FCC phase which gives an average size of 28.54 nm [21]. A small peak observed at around 25° indicates that a small amount of copper is oxidized and converted into copper oxide.
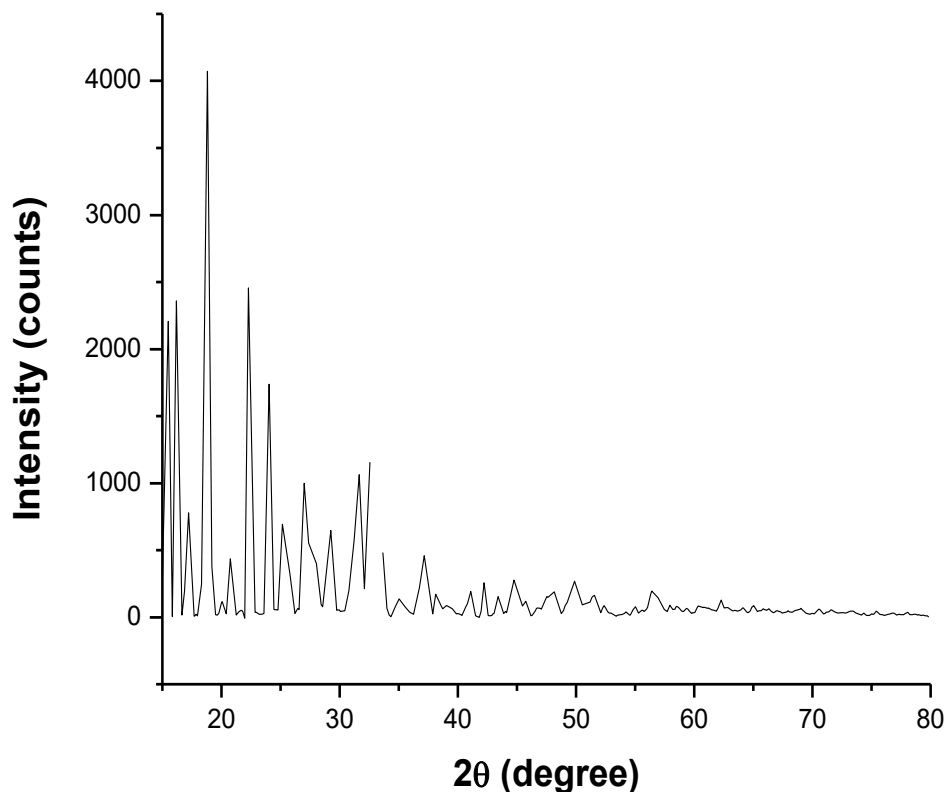
Figure 3. XRD Pattern of Cu nanoparticles from Pepper seed extract

3. 2. Scanning Electron Microscopy (SEM) analysis

The surface morphology of the nanoparticles was taken by Scanning Electron Microscopy (SEM) analysis. Scanning Electron Microscopy gives further insight into the morphology and size details of the copper nanoparticles. The SEM photograph shows that the synthesized Copper nanoparticles are asymmetrical dispersed and aggregated infrequently to form free crystal structures.

The Surface Morphology of synthesized copper nanoparticles from Tulsi extract is shown in Figure 4. From the image it is clear that the existence of unsymmetrical spherical tiny copper nanoparticles settled on extract residue as the sample was prepared by the method of evaporation. However, it was not possible for us to investigate the exact surface texture of the observed nanoparticles. SEM images of copper nanoparticles prepared from Pepper Seed extract are shown in Figure 5.

Copper nanoparticles prepared by this method show nearly monodispersed distribution of particle sizes, with some traces of lumped particles observed forming bulky micron sized aggregates.
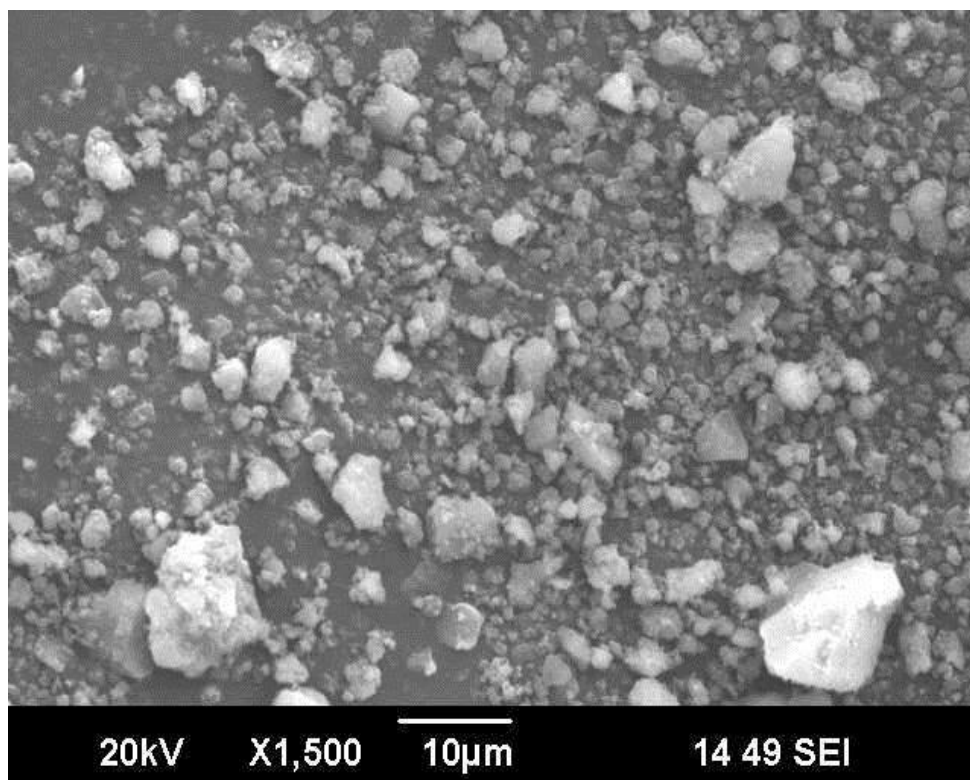
(a)
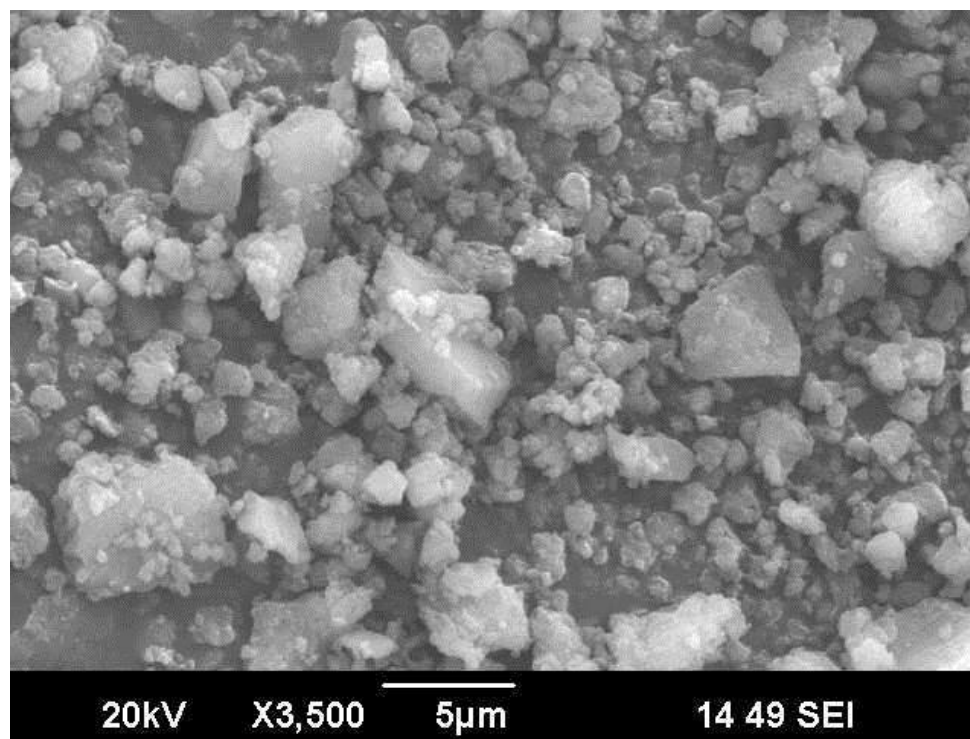
(b)
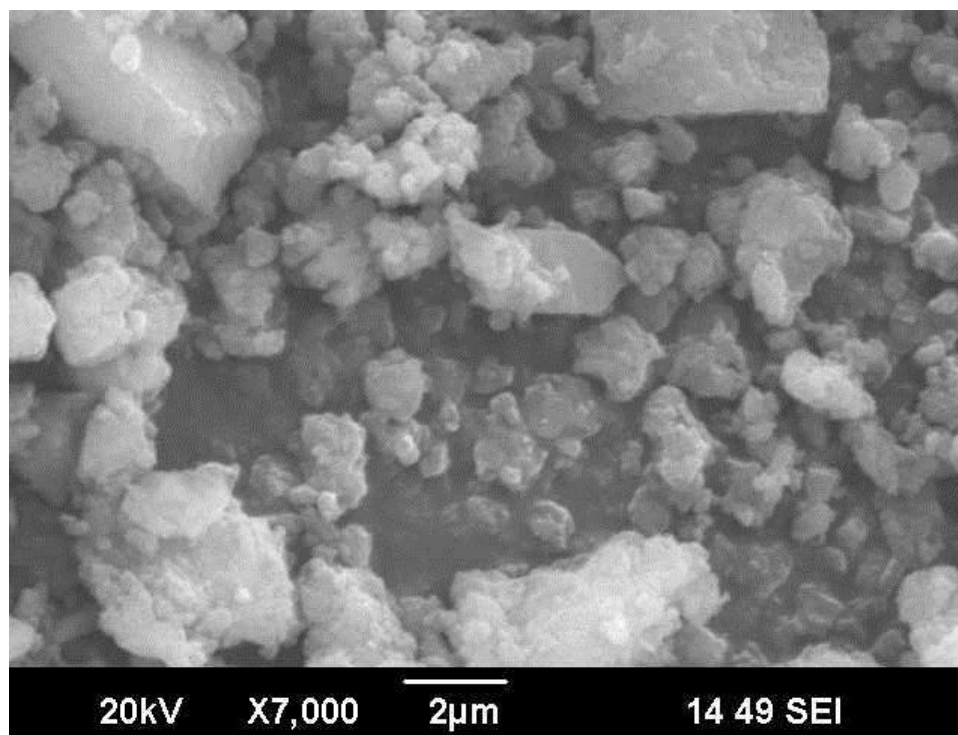
(c)
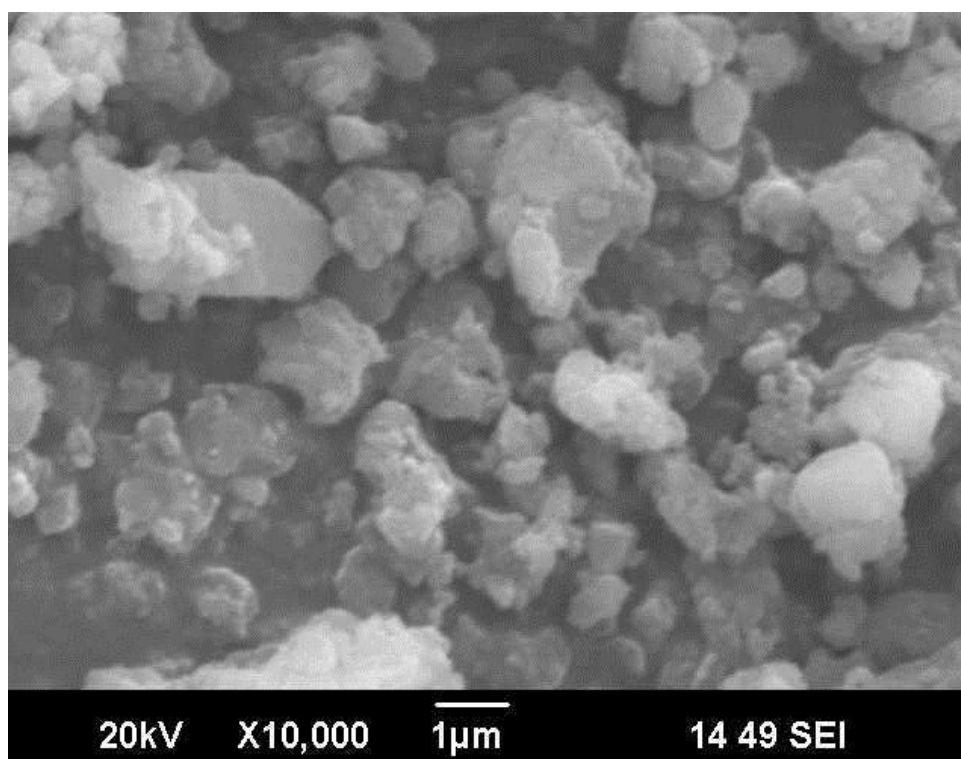
(d)

Figure 4(a,b,c,d). SEM images of Cu nanoparticles prepared from Tulsi extract
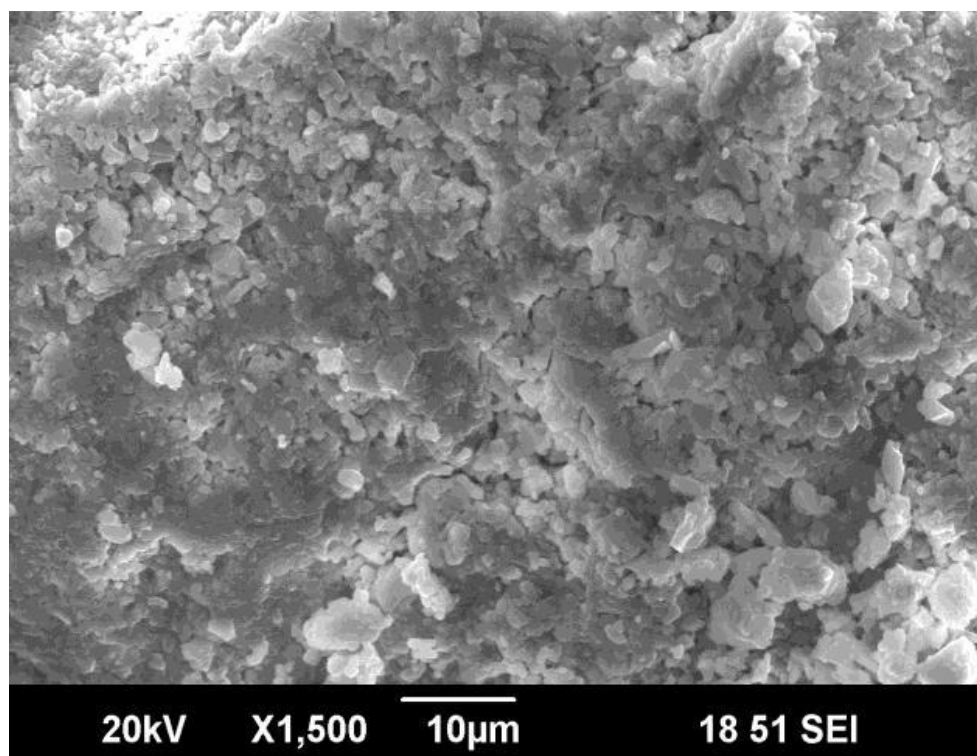
(a)
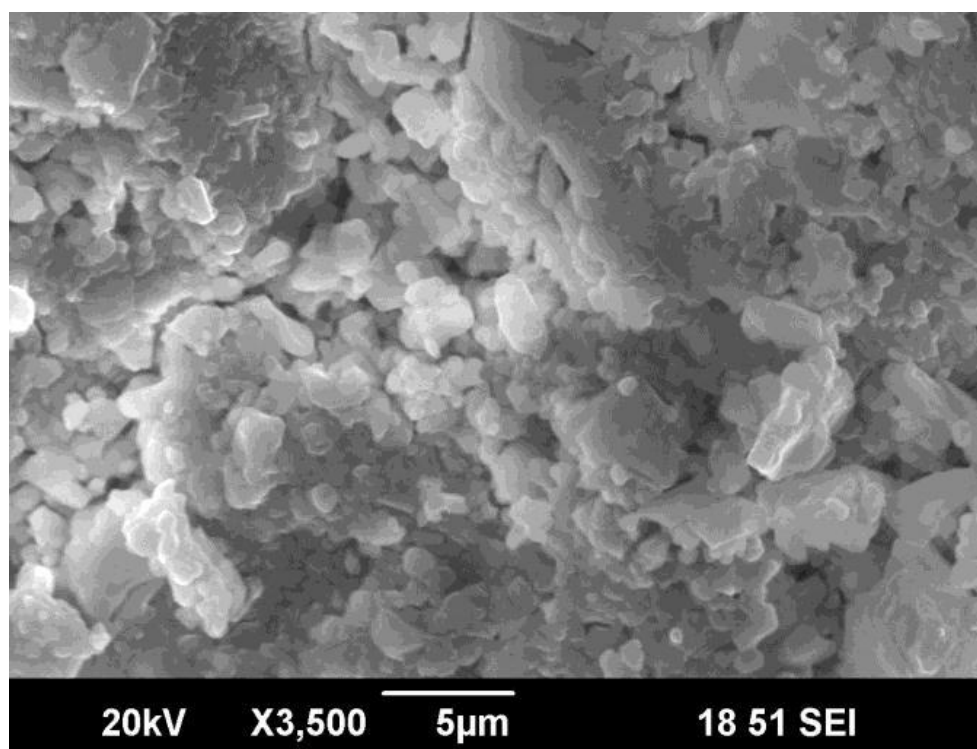
(b)
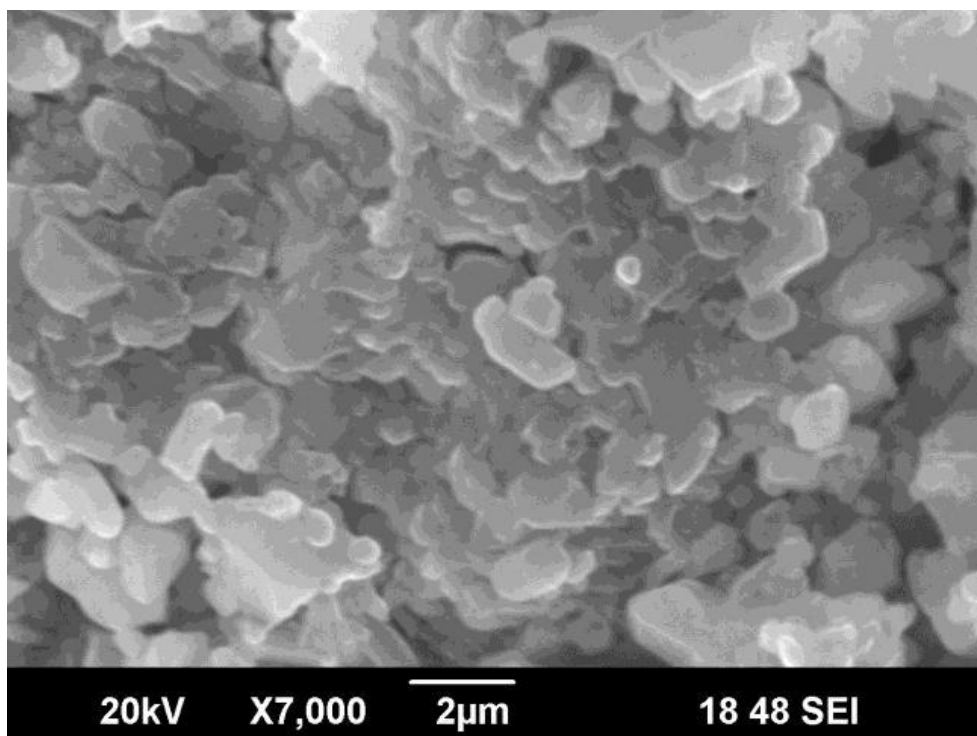
(c)
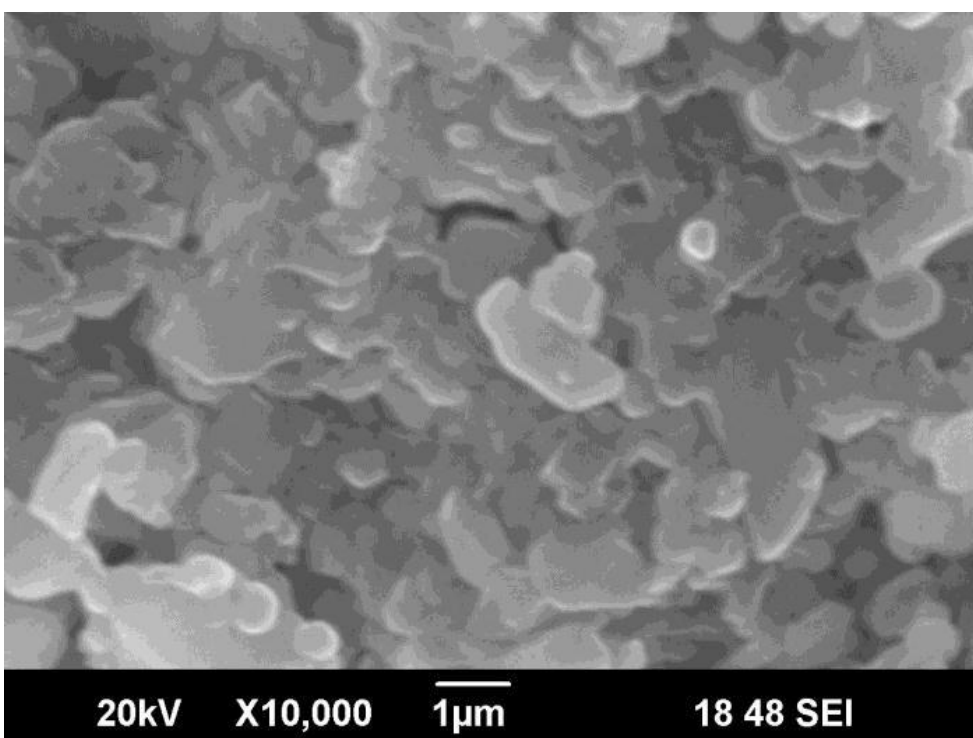
(d)

Figure 5(a,b,c,d). SEM images of Cu nanoparticles prepared from Pepper seed extract

3. 3. FTIR analysis

FTIR spectrum of Copper nanoparticles synthesized from thulsi extract is shown in Figure 6. The broadband around 3200 cm^{-1} which are characteristics of the hydrogen bonded phenols and alcohols.
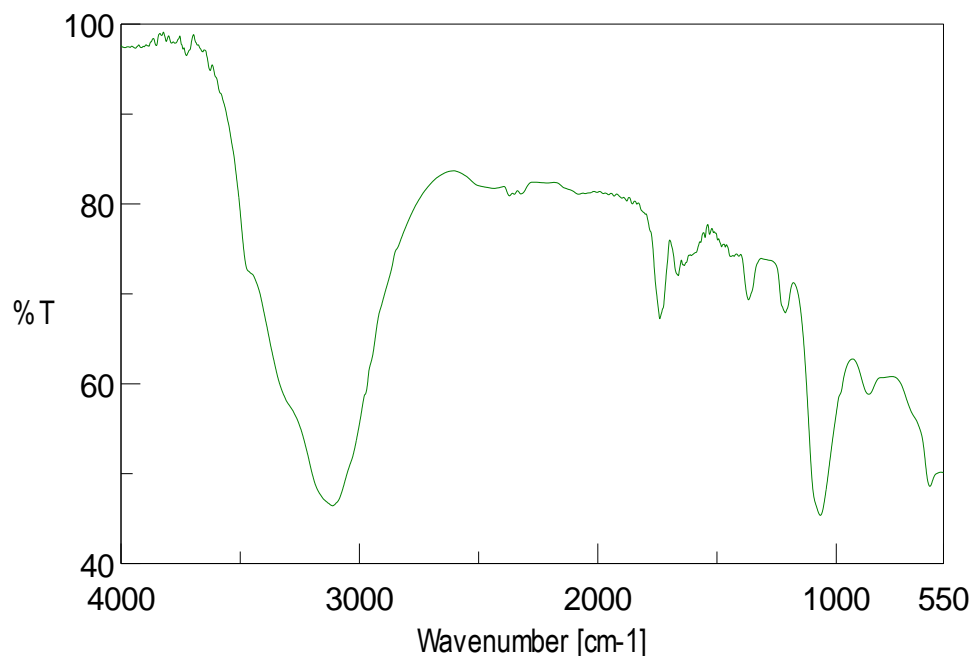
Figure 6. FTIR Spectrum of of Cu nanoparticles prepared from Tulsi extract

The band observed around 1610.45 cm^{-1} are assigned to N-H bending as well as C=O stretching vibration of amino acids. The bands in the region 1100.21- 1600.65 cm^{-1} were due to the stretching vibrations of various C–O and C–N present in the thulsi leaf extract. Thus, it is clear that the presence of flavones and polysaccharides in the leaf extract and the shifting of the respective bands confirm the binding of copper with the functional groups or its capping to provide further stability [22].

This also confirms that water soluble compounds such as terpenoids, which are present in leaf extract have the ability to perform dual functions of reduction and stabilization of copper nanoparticles.

Figure 7 shows the FTIR spectrum of Cu nanoparticles prepared from pepper extract. The IR spectrum of Cu nanoparticles shows band at 3373 cm^{-1}, 1635 cm^{-1}, 1516 cm^{-1}, 1376 cm^{-1}, 1198 cm^{-1} corresponds to O-H Stretching H-bonded alcohols and phenols, carbonyl stretching, N-H bend primary amines, corresponds to C-N stretching of the aromatic amino group and C-O is stretching alcohols, ethers respectively. The band at 624 cm^{-1} is due to acetylenic C–H bending vibrations.

FTIR spectrum of Cu nanoparticles suggested that Cu nanoparticles were surrounded by different organic molecules such as terpenoids, alcohols, ketones, aldehydes and carboxylic acid.

Figure 7. FTIR Spectrum of Cu nanoparticles prepared from Pepper Seed extract

4. CONCLUSIONS

Copper nanoparticles have been synthesized by Green Synthesis method (from Tulasi extract and Pepper seed extract). The XRD analysis confirmed the crystalline size of Copper Nanoparticles.

The calculated crystalline size of Copper nanoparticles prepared from Tulsi extract is found to be 26 nm and for the Copper nanoparticles prepared from Pepper extract is about 28 nm. The crystalline size of the Copper Nanoparticles prepared from Tulsi extract is little smaller than Copper nanoparticles prepared from Pepper extract.

SEM images of Copper nanoparticles showed that the cluster formation presence of smaller and larger grains. FTIR analysis revealed that the functional groups present in the Copper nanoparticles prepared from both Tulsi and Pepper extract.

From the above results showed that the synthesized Copper nanoparticles could have a large number of applications in the field of electrode materials in different rechargeable batteries, catalytic agent, anti-microbial, anti-fungal, anti-biotic, nanosensor, super conducting material, solar cell application.

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ORIGINAL ARTICLE

Synthesis and characterization of SnO$_2$ nanoparticles by co-precipitation method

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Abstract

Tin oxide (SnO$_2$) nanoparticles were synthesized by co-precipitation method and the synthesized nanoparticles were annealed at different temperatures for characterization. The powders were investigated with X-ray diffraction, scanning electron microscopy and optical spectroscopy. The structural characterization was carried out by X-ray diffraction which confirms the crystalline nature of the films with a tetragonal structure. SEM analysis of the powders enabled the conclusion that the prepared nanoparticles are spherical particles which are smaller in size composed of clustered and agglomerated nanoparticles. From the absorption spectra the type of transition and band gap of the synthesized nanoparticles were estimated. The optical (UV-visible) spectrum exhibits a well defined absorption which in considerably blue shifted related to the peak absorption of bulk SnO$_2$ indicating quantum size effect.

Keywords: *Morphological Properties; Optical Properties; Quantum Size Effect; Structural Properties; Tetragonal Structure; Tin Oxide Nanoparticles.*

INTRODUCTION

Nanomaterials have attracted great interest due to their intriguing (unique electrical, physical, chemical, and magnetic) properties, which are different from those of their corresponding bulk state. Enormous efforts are being taken towards the development of nanometer sized materials in studies related on one hand to their fundamental mechanism such as the size effect, the quantum effect and on the other hand towards application of these materials. With decreasing particle size the band structure of the semiconductor changes; the band gap increases and the edges of the bands splits into discrete energy levels. These so-called quantum size effects occur [1-11]. Nanometer sized material and semiconductor particles have a large potential for industrial applications. Metal oxide semiconductors are low cost and effective gas sensing material. Among the various metal oxide semiconductors, SnO$_2$ have been attracting much attention since they are highly conducting, transparent and sensitive to gases. SnO$_2$ is highly interesting as it is an n-type semiconductor with direct band gap of 3.6 eV between the full oxygen 2p Valence band and the tin states at the bottom of the conduction band and offers many technological applications such as catalysts for oxidation of organics, solid state gas sensors, conducting films, environmental monitoring, biochemical sensor, lithium rechargeable batteries, solar cells [12], dye-sensitized solar cells. [13-17].

Earlier workers synthesized SnO$_2$ nanoparticles by various methods like Sol Gel [18] Micro Wave technique [19] Solvo-thermal [20], Hydro thermal [21], Sonochemical [22] Mechanochemical [23], Co-precipitation [24]etc., Of the various methods Co-precipitation method is simple, inexpensive and does not require high temperature and pressure. In this method the size and shape of the particle can be controlled by altering pH of the

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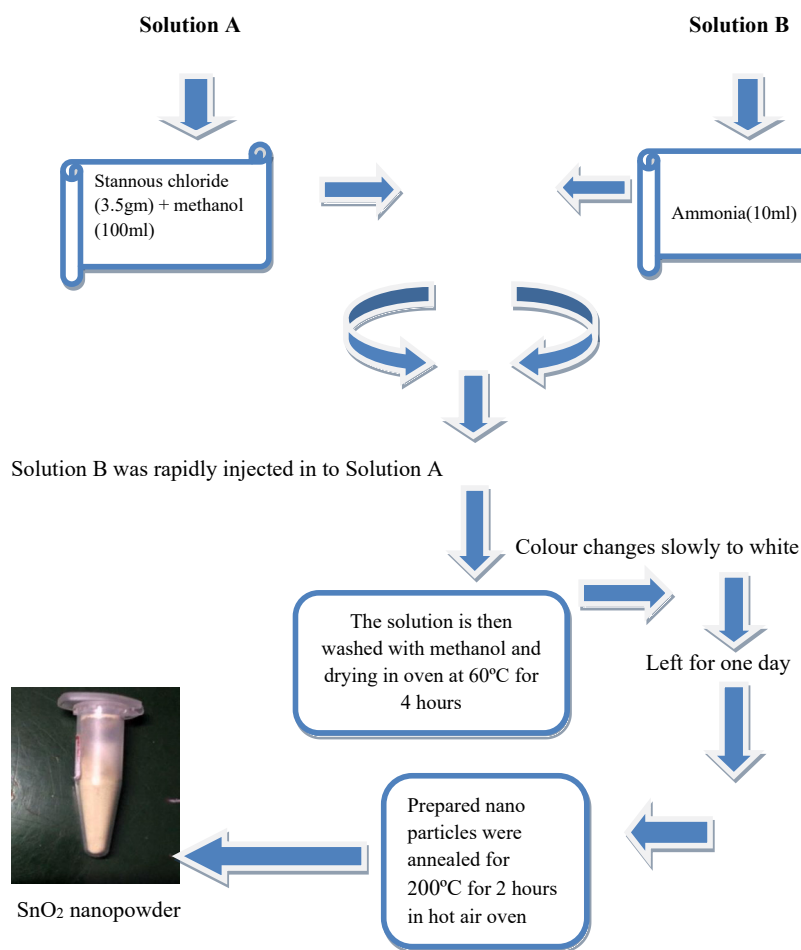
Fig. 1. Schematic representation of synthesis of SnO_2 nanoparticles.

medium, concentration of the precursor and precipitating reagents. Impurities in the precipitate were easily eliminated by filtration and repeated washing and after some time the particles undergo aggregation. Therefore focus has been given to synthesize pure and highly crystalline SnO_2 nanoparticles using Co-precipitation method.

EXPERIMENTAL DETAILS

In the present work Tin oxide (SnO_2) nanoparticles were synthesized by co-precipitation method using precursor's stannous chloride and methanol. Solution A contains 3.5gm of stannous chloride which was dissolved in 100ml of methanol and kept in a magnetic stirrer for 20-30 minutes. Solution B contains 10ml of Ammonia (NH_3), was rapidly injected in to solution A under continuous stirring for 30 minutes. Following rapid injection,

a white precursor was obtained and the reaction system gradually becomes transparent and the color changes slowly, now the color changes from transparent to white. The white colour precipitate was taken out by filtering and then the filtered powder was washed with methanol for once. The washed nanoparticles were dried at 60 ºC for 4 hours by using hot air oven. The prepared nanoparticles were annealed 200 ºC for 2 hours in hot air oven for characterization. The schematic representation of synthesis of SnO_2 nanoparticles is presented in Fig 1. Structural characterization of these films was carried out by using Shimadzhu (Lab X-6000) x-ray diffractometer with Cu Kα (λ = 1.5406 Å) line in 2θ range from 20 to 80 degrees. A JASCO (V570: UV-VIS-NIR) double beam spectrophotometer was used for optical studies in the wavelength range 400–2500 nm.
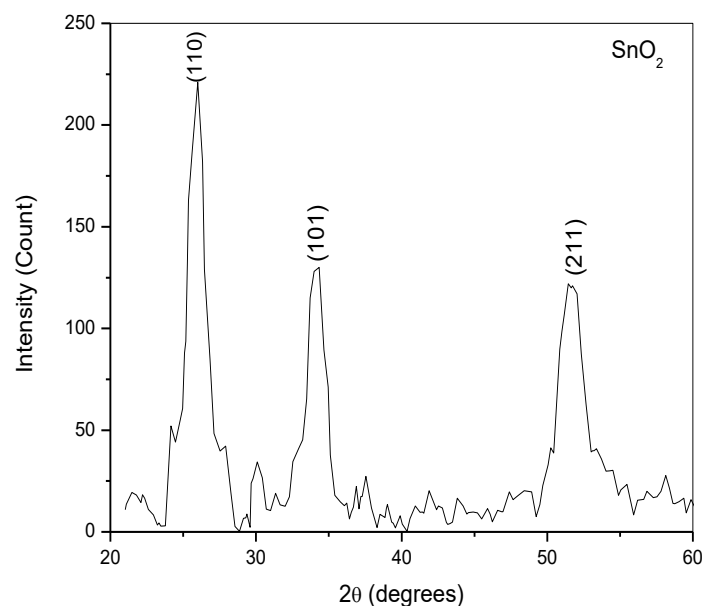
Fig. 2. XRD diffractogram of SnO$_2$ nanoparticles.

Table 1: Structural parameters of SnO$_2$ nanoparticles.

Sample	Interplanar spacing 'd' (nm)	2θ (degrees)	(hkl) Planes	Lattice constants		Crystallite size(nm)
				'a'(Å)	'c' (Å)	
	3.3670	26.46	(110)	4.1610	-	20.45
SnO$_2$	2.6582	33.70	(101)	4.7730	3.200	29.49
	1.7741	52.40	(211)	4.7660	3.201	27.71

RESULTS AND DISCUSSION

Structural Analysis of SnO$_2$ nanoparticles

The X-ray diffraction pattern of SnO$_2$ nanoparticles prepared by Co-Precipitation method is presented in Fig. 2, which confirms the polycrystalline nature of the prepared SnO$_2$ nanoparticles. Similar X-ray diffractograms were reported for SnO$_2$ nanoparticles prepared by different methods by the earlier researchers [1-3, 17, 25-28].

From the diffraction profile the diffraction angles and the intensity of lines were measured with greater accuracy. The predicted peaks (110) (101) and (211) are reported as the identifying peaks for SnO$_2$ nanoparticles by earlier reporters [1-3,17, 25-28] and JCPDS file of SnO$_2$ (JCPDS 41-1445). From the diffraction profile it has been found that the prepared SnO$_2$ nanoparticles are polycrystalline in nature [28] with tetragonal structure, having the preferential orientation along (110) plane. The intensity of the peak (110) increases significantly faster than the other peaks.

The lattice parameters 'a' and 'c' for the SnO$_2$ nanoparticles of tetragonal structure were evaluated by using the relation,

$$\frac{1}{d^2} = \left(\frac{h^2 + k^2}{a^2} \right) + \frac{l^2}{c^2}$$

The crystallite size (D) of the SnO$_2$ nanoparticles were estimated using Debye Scherrer's formula,

$$D = \frac{0.9\lambda}{\beta \cos\theta}$$

where, λ the wavelength of the radiation is source (CuKα) and β is the full width at half maximum of the corresponding peak of the XRD pattern.

From the observed 'd' spacing, (hkl) planes, the lattice constants were calculated using the above relation [Table 1] and are in good agreement with earlier reporters [28-31]. The average crystallite size (*D*) evaluated from the XRD spectra using Scherer's formula lies between 20 nm and 27nm, presented in Table [1].

SEM analysis of SnO₂ Nanoparticles

Scanning Electron Microscopy (SEM) was employed to analyze the morphology and growth features of aggregates of the as prepared SnO$_2$ nanoparticles with different magnification. In Fig. 3 (a, b) SnO$_2$ particles with nano sized dimension are interconnected, which shows strong agglomeration accompanied with a lot of small spherically shaped particles. This agglomerate actually consists of much larger grains of about 100–200 nm in diameter [17]. Particle size and distribution of nanoparticles mainly depend upon the relative rates of nucleation and growth processes, as well as the extent of agglomeration [29].

It is interesting to note that, when magnification increased SnO$_2$ particles are fine and some agglomeration of finer particulates to form bigger clusters. However there is some non-uniformity in the shape and the existence of porosity observed in Fig. 3(c & d) [32]. The measured average particle size of the tin oxide particles from the SEM image Fig. 3(e) was around 160 nm.

Optical analysis of SnO₂ Nanoparticles

The most dramatic property of semiconductor nanoparticles is the size evolution of the optical absorption spectra. Hence UV–visible absorption spectroscopy is an efficient technique to monitor the optical properties of quantum-sized particles. The absorption spectrum of the nanoparticles of SnO$_2$ is shown in Fig. 4. The spectrum exhibits a well-defined absorption feature (peak) at ~328 nm
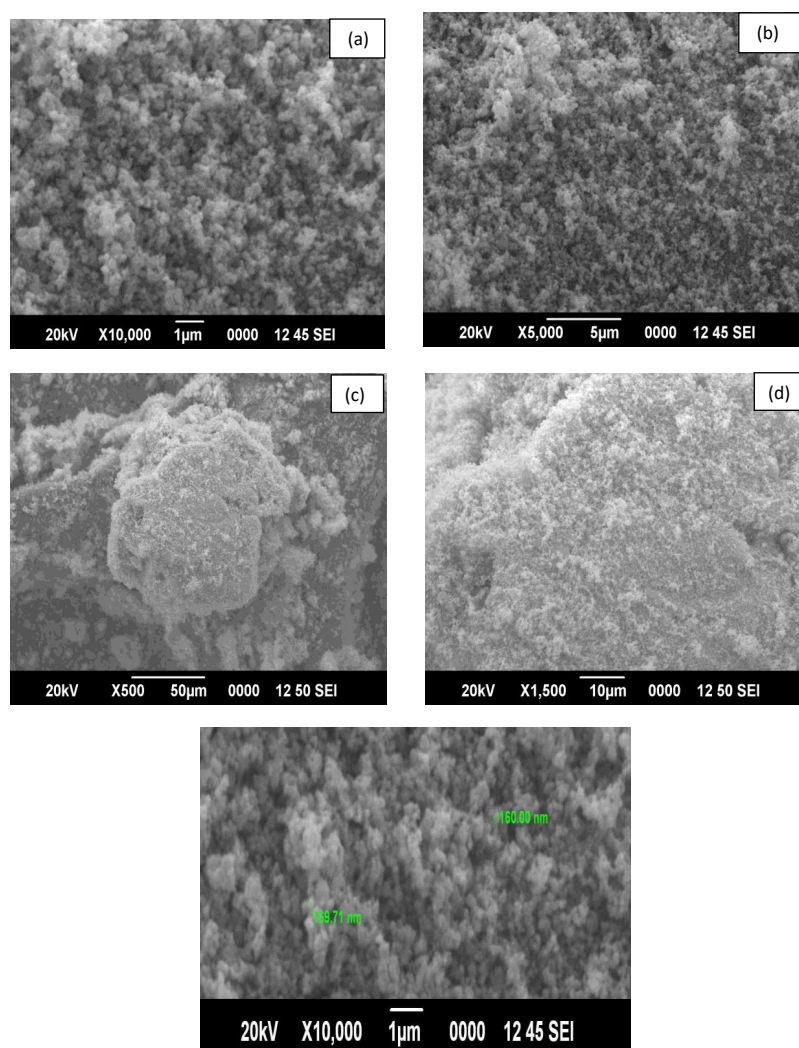
Fig. 3 (a, b, c, d, e). SEM image of SnO$_2$ nanoparticles (Particle size is indicated in green colour).
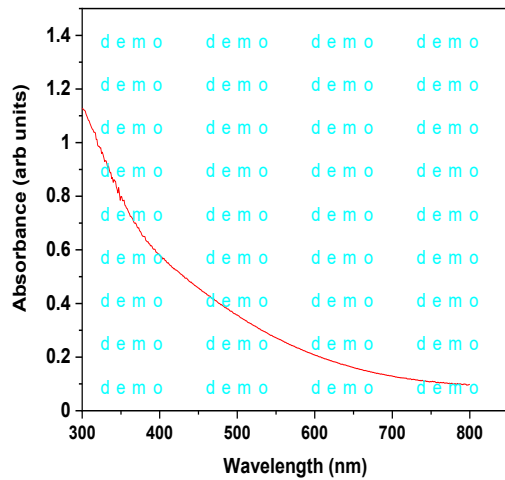
Fig. 4. Optical absorption spectra of SnO_2 nanoparticles.
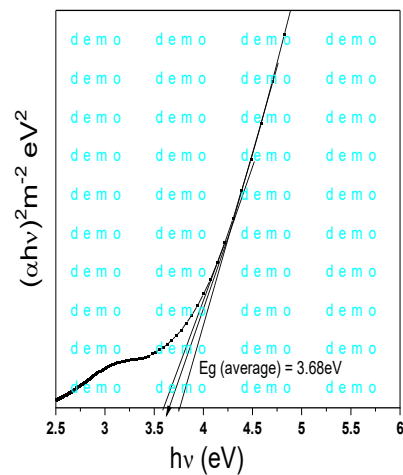
Fig. 5. Plot of $(\alpha h\nu)^2$ vs (hv) for SnO_2 nanoparticles.

corresponding to the band gap of 3.77 eV (E=hυ) which is considerably blue-shifted by 0.17 eV relative to the bulk SnO_2 value (3.6 eV). It is clear that the obtained tin oxide has the optical band gap larger than the value of 3.6 eV for bulk SnO2 which can be attributed to quantum confinement effect [24, 28, 33-35].

From a quantum mechanical basis and appropriate selection rules, it is possible to find out the nature of electronic transition from the absorption of photon energy by using the relation,

$$\alpha = \frac{A\left(h\upsilon - E_g\right)^r}{h\upsilon}$$

where A is a constant and E_g is the energy band gap. The optical energy band gap is the minimum energy required to excite an electron from the valance band to the conduction band by an allowed optical transition [36]. $(\propto h\nu)^2$ versus (hv) for SnO_2 nanoparticles is shown in Fig. 5. The straight line extrapolated to the energy axis has been rotated many times and the band gap has been estimated each time [37] and the average value is given by 3.68 eV. The observed band gap value is in agreement with earlier reported values and which is considerably blue-shifted by 0.08 eV relative to the bulk SnO_2 value (3.6 eV) [26, 29, 38, 39].

The dependence of particle size of the SnO_2 nanoparticles can be determined experimentally from the band gap energy inferred from the optical absorption spectra, which is expressed from an effective mass model [39, 40]. Using effective mass equation the calculated optical band gap energy for SnO_2 nanoparticles was found to be 3.65 eV. The optical band gap energy (*Eg*) was calculated using effective mass equation and from Tauc's relation as 3.65 eV and 3.68 eV, respectively. Hence the optical band gap energy value appears slightly lower than the calculated band gap energy value (effective mass model Eg = 3.65) due to a tight-binding model used in the experimental data (optical absorption spectra) [39].

Band gap values estimated from different methods were in good agreement with the earlier reporters on SnO_2 nanoparticles. The wide direct band gap makes these particles good material for potential applications in optoelectronic devices such as multilayer dielectric filters and solar cells [41].

CONCLUSION

SnO_2 nanoparticles have been synthesized by co-precipitation method. The XRD analysis confirmed that the crystalline structure of SnO_2 nano particles as tetragonal. The structural parameters such as crystallite size, lattice constants a & c has been calculated [a=4.161 nm, c=3.200 nm] which were in well agreement with JCPDS data and earlier reporters. SEM image of SnO_2 nano particles showed that the present nano sized spheres and some agglomeration with larger grains. The UV-visible spectrum exhibits a well defined absorption peak at ~328 nm corresponding to the band gap of 3.77 eV, optical band gap of 3.68 eV estimated from Tauc's plot and optical band gap of 3.65 calculated using effective mass equation were considerably blue shift, related to the peak

absorption of bulk SnO_2 (3.6 eV) indicating quantum size effect. From the results, the synthesized SnO_2 nanoparticles by co-precipitation method could have large number of potential application in the field of optoelectronic devices and solar cell applications.

ACKNOWLEDGEMENT

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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Non-conventional photoactive transition metal complexes that mediated sensing and inhibition of amyloidogenic aggregates

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ARTICLE INFO

ABSTRACT

Alzheimer's disease (AD), a devastating neurodegenerative disease, is associated with the abnormal accumulation and aggregation of β-amyloid proteins (Aβ) along with the deposition of high levels of Cu, Fe and Zn ions in the brain, causing neuronal cell deaths to lead the cognitive disabilities and even death. As there is a direct relationship between AD and Aβ aggregation, an intense research activity has been made to develop drug materials that serve as probes and inhibitors for controlling the pathways of Aβ peptide aggregation. However, their relatively instability in aqueous medium, tedious sample treatment, multistep syntheses, or low detection ability limit their potential applications. Therefore, the development of photoactive metal complexes for the selective detection and inhibition effects of Aβ aggregation is a thrust area in biomedical research. In this review, the use of non-conventional photoactive metal complexes including Ru(II), Re(I), Ir(III) and Pt(II) has the potential advantages of probes for monitoring and inhibiting the fibrillation as well as the toxicity of Aβ over conventional dyes such as Thioflavin T (ThT). The geometry, multiple electronic/spin states and redox nature of metal centres have made them tunable properties. Upon binding to the Aβ peptide aggregates, they exhibit promising potential as anti-AD agents due to their fascinating photophysical properties include red emissions, large Stokes shifts, and long lifetimes, which differentiate the competitive binding of other short-lived fluorescent molecules via photoluminescence, and time-resolved measurements. In addition, metal complexes display their remarkable selectivity and superiority over ThT. Competition study between photoactive metal complexes and ThT on fibrillation process show their effective binding of metal complex with Aβ42 fibrils by hindering the ThT binding to give higher binding constants than that of ThT. Computational studies predicted a hydrophobic domain between amino acid binding sites and the functional group of photoactive metal complexes via different noncovalent interactions. Thus, attractive characteristics of photoactive metal complexes could influence remarkable evolutions in new dimensions, which in turn address current challenges in the clinical use of the detection and inhibition of Aβ fibrils.

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Imidazolatic-Framework Bimetal Electrocatalysts with a Mixed-Valence Surface Anchored on an rGO Matrix for Oxygen Reduction, Water Splitting, and Dye Degradation

Raja Palani, Venkatasamy Anitha, Chelladurai Karuppiah, Subramanian Rajalakshmi, Ying-Jeng Jame Li, Tai-Feng Hung, and Chun-Chen Yang*

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ABSTRACT: This paper presents a simple strategy for manufacturing bifunctional electrocatalysts—graphene nanosheets (GNS) coated with an ultrafine NiCo-MOF as nanocomposites (denoted NiCo-MOF@GNS) having a N-doped defect-rich and abundant cavity structure through one-pool treatment of metal–organic frameworks (MOFs). The precursors included N-doped dodecahedron-like graphene nanosheets (GNS), in which the NiCo-MOF was encompassed within the inner cavities of the GNS (NiCo-MOF@GNS) at the end or middle portion of the tubular furnace with several graphene layers. Volatile imidazolate N_x species were trapped by the NiCo-MOF nanosheets during the pyrolysis process, simultaneously inserting N atoms into the carbon matrix to achieve the defect-rich porous nanosheets and the abundantly porous cavity structure. With high durability, the as-prepared nanomaterials displayed simultaneously improved performance in the oxygen reduction reaction (ORR), the oxygen evolution reaction (OER), and photocatalysis. In particular, our material NiCo-MOF@GNS-700 exhibited excellent electrocatalytic activity, including a half-wave potential of 0.83 V ($E_{ORR, 1/2}$), a low operating voltage of 1.53 V ($E_{OER, 10}$) at 10 mA cm^{-2}, a potential difference (ΔE) of 1.02 V between $E_{OER, 10}$ and $E_{ORR, 1/2}$ in 0.1 M KOH, and a low band gap of 2.61 eV. This remarkable behavior was due to the structure of the defect-rich porous carbon nanosheets and the synergistic impact of the NPs in the NiCo-MOF, the N-doped carbon, and NiCo-N_x. Furthermore, the hollow structure enhanced the conductivity and stability. This useful archetypal template allows the construction of effective and stable bifunctional electrocatalysts, with potential for practical viability for energy conversion and storage.
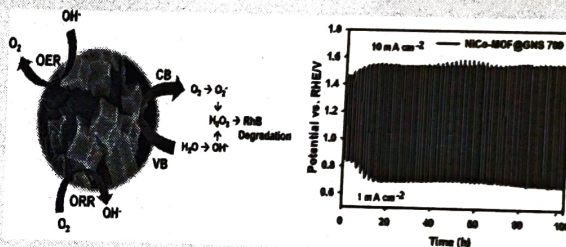
INTRODUCTION

Widespread efforts have been made to develop renewable energy technologies, including fuel cells, metal–air batteries, water splitting devices, and heterogeneous catalysis, to meet the rapidly expanding demands for clean green energy and environmental remediation.[1−4] The applicability of heterogeneous catalysis is continuously growing, along with demands for new effective catalysts. Such energy storage devices might also require catalysts for the oxygen reduction and oxygen evolution reactions (ORR and OER, respectively) for water division, as well as for photodegradation, to directly enhance their energy conversion and storage efficiencies.[5] Systems for effective water splitting and photocatalysis, however, require semiconductor catalysts that can efficiently drive the water splitting process by absorbing solar light and subsequently generating excitonic charge carriers.[6−8] To achieve successful bifunctional ORR and OER water splitting, as well as dye degradation, a catalyst material should display a desirable band edge position with respect to water oxidation, a low degree of electron–hole recombination, high electrochemical activity in water, and rapid charge transport.[9,10]

Various inexpensive, stable, and earth-abundant electrocatalysts have been tested to date for their merits in ORR and OER catalytic operations; among them, transition-metal oxides (TMOs) are promising substitutes for noble-metal catalysts (e.g., Pt, Au, Pd).[11−14] Most TMOs, however, display poor electronic conductivity, ready aggregation of nanoparticles (NPs), and a low surface area, resulting in unsatisfactory bifunctional catalytic activities; this problem be alleviated by mixing graphene nanosheet (GNS) materials with TMO NPs.[15−17] Because of their excellent physicochemical properties (e.g., high surface area, excellent electrical conductivity, electrochemical stability, and ease of surface modification), nanostructured carbonaceous materials [e.g., GNS, carbon

Non-conventional photoactive transition metal complexes that mediated sensing and inhibition of amyloidogenic aggregates

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Performance Analysis Of Health Insurance Companies In India

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Abstract

Man can live without education and without luxuries like a big bungalow or an extravagant Car but cannot afford to live without proper health. When we talk of people living below poverty line, it becomes all the more important. For a common man who cannot afford to get quality medical treatment when he falls sick, some alternatives have to be found. Therefore it is imperative that he has to avail health insurance scheme which is the only mechanism that would meet his needs at the appropriate time of his need. "Health insurance is an insurance against loss by illness or bodily injury. It provides coverage for medicine, visit to doctor or emergency room, hospital stays and other medical expenses. Policies differ in respect what they cover, the size of deductible and/or co-payments, limit of coverage and the option for treatment available to policyholders".

Key words: Emotion, Health, Insurance, Policy, Premium

Introduction

Man is a social animal. He constantly goes in search of his companions and wants to remain in a group. He cannot even dream of being isolated for the fear of uncertainty grapples him. To ensure emotional and social security he seeks family relationship. This has given him protection and makes him feel comfortable. This mental state which seeks solace, security and comforts is conveniently met by groups. These groups assure him of his financial stability and these groups may he his employer, or it can be his government or an insurance company. Despite all the tall claims of protection, man today is facing more threats to his financial stability than his forefathers.

When our ancestors lived in groups, they had physical and economic security but with the advent of industrialization, the families got segregated. To make him feel free and secure, the insurance companies were formed. The vey term "insurance", signifies that the losses can be substituted by what is called "premium". Therefore it is evident that the basic aim of the insurance is to make one policy holder received his lost property by making a large numbers of policy holders of the same insurance company to pay.

So insurance is a contract in which a person whose loss or risk is shifted called "Insured" and the party to whom the loss or risk is shifted called "Insurer" and the consideration paid by the insured to insurer is called "Premium and the contract in which terms and conditions of insurance are mentioned is called "Insurance Policy".

Key Terms Associated with Health Insurance and their Description

S. No.	Key Terms	Description
1	Agent	An agent is appointed by the insurer to conduct business on behalf of the insurance company. An agent must hold a license issued by the IRDA.
2	Claim	The process of applying to the insurer for reimbursement of expenses incurred for treatment is called "filing a claim".
3	Policy	The legal document issued by the insurance company that outlines the terms and conditions of the insurance.
4	Policyholder	The person who buys the insurance and also called the "insured".
5	Premium	The payment required to keep your insurance policy in force.
6	Cashless Services	The insurer or its TPAs have tie-ups with network of hospitals. The insured can get treatment for the disease contracted without any cash payment from this network of hospitals called cashless services.
7	Coverage Amount	It is the maximum amount payable in the event of a claim. It is also known as "sum insured" and "sum assured".
8	Group Insurance	A firm or an association may buy a policy to insure members of a group. For example a Company may take a policy to cover a large group of its employees.
9	Cumulative Bonus	Each claim free year ensures that you get a benefit known as "cumulative" bonus and it is similar to "no claim discount" concept.
10	Domiciliary Hospitalization	When treatment of a patient is carried out at home, as per the doctor's recommendation called domiciliary hospitalization.
11	Moral Hazard	It is a term used to describe the phenomena where the customer seek an undue advantage, as a result of buying insurance or where customer has not acted in good faith and has provided misleading information.
12	No Claim Discount	It is a discount on the basic premium, if there is a claim free year of the policy. In other words, if the insured does not make any claim on his/her policy, then he/she gets a discount (from 5% to 25%) on basic Premium for every claim free year.
S. No.	Key Terms	Description
13	Pre-existing Disease	A pre-existing disease is any ailment or disease with which a person is already suffering at the time of purchasing health insurance.
14	Renewal	Health insurance policies are usually annual contracts. At the end of the policy period, the policy has to be renewed by the insurers.
15	Reimbursement	Under Health Insurance policy, the cost of various hospital charges (such as bed charges, medicines, lab tests, surgeon's fees etc) are paid back to the insured who logged/makes the claim.
16	Deductible	It can be defined as the amount of expenses that must be paid out of pocket before an insurer will cover any medical expenses.
17	Benefit	The amount payable by the insurance company to a plan member for medical costs.
18	Individual health insurance	Health insurance plans purchased by individuals to cover themselves and their families. Different from group plans, which are offered by employers to cover all of their employees.

20.	Underwriting	The process by which health insurance companies determine whether to extend coverage to an applicant and/or set the policy's premium.

Source:http://www.medindia.net/patients/insurance/healthcare-insurance-terms-and definitions.htm and *https://www.wpsic.com/members/smart-consumer/healthinsuranceterminology.shtml* assessed on Oct 2015).

Review of literature

Nair (2019) has made a comparative study of the satisfaction level of health insurance claimants of public and private sector general insurance companies. It was revealed that majority of the respondents had claim of reimbursement nature through third party administrator. Satisfaction with respect to settlement of claim was found relatively higher for public sector than private sector. Yadav and Sudhakar (2017) studied personal factors influencing purchase decision of health insurance policies in India. It was found that factors such as awareness, tax benefit, financial security and risk coverage has significant influence on purchase decision of health insurance policy holders.

Significance of the study

The study is covered only public sector fields and academicians in order to realize the financial growth and impact of health insurance in India. The company wise growth is to identify the strong and weak position of the companies inside and outside.

Statement of the problem

The insurance companies are undertaking multi-faceted activities. Any evaluation of their performance has to take into account the entire stream of activities and functions performed by them. Against this backdrop, the researcher has to study the Performance Analysis of Health Insurance Companies in India. In the above background, the researcher has raised the following questions in mind infavour of health insurance in India.

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❖ To analyse the liquidity position of Public health insurance companies in India.

Hypotheses of the study

❖ **Ho1:** There is no impact between net profit profitability and liquidity position of Public health insurance companies in India.

Research Methodology

The purpose of the present study was to study the Performance of analysis of Health Insurance Companies in India. Public Insurance Companies taken for the study were New India Insurance Company, National Insurance Company, Oriental Insurance Company and United Insurance Company.

Sources of Data

The secondary data has been collected and compiled from Capitaline Database. In addition other required information was collected through the magazines, relevant journals and websites etc.

Period of the Study

The study covers the period of nine year from the Business year 1ˢᵗ April 2019 to 31ˢᵗ March 2020 audited financial statements were taken into study

Limitations of the study

➢ The report consists of nine years ranging from 2019 April to 2020 March. The data before and after the period are excluded for the study on basis of availability of data from Insurance Claim Management.

Tools used

➢ Composite Liquidity Analysis

LIQUIDITY ANALYSIS

This study analyses, the Public Health Insurance Companies liquidity by ascertaining the various measures. The current assets should be either liquid or near liquid. It should be convertible into cash for

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paying of short term in nature. The sufficiency or insufficiency of current assets should be assessed by comparing with short term liabilities. Liquidity is not merely paying off the debts due but also ensuring adequate productivity and profitability with sufficient credit rating and a continuous re-engineering process on the assets, and paying a reasonable dividend to its shareholders. Thus, liquidity is required to support the total operations of the firm. To examine the liquidity of Public Health Insurance sectors and the following liquidity ratios are employed. Fixed assets to Net worth ratio, Current assets to Net worth ratio, Working Capital ratio, Current assets to Turnover ratio, Fixed assets to Turnover ratio, Net profit Total assets ratio and Dividend paid to Total income ratio.

COMPOSITE LIQUIDITY ANALYSIS OF PUBLIC HEALTH INSURANCE COMPANIES IN INDIA

Table 1 shows the Composite Liquidity Analysis of Public Health Insurance Companies in India during the period from April 2019 to March 2020.

Table 1

Composite Liquidity Index Analysis of Public Health Insurance Companies in India during the period from April 2019 to March 2020(In Percentage)

Sectors	FATR	CATR	WCR	CANR	FANR	NPTAR	DPTIR	Total	Rank
United India Insurance	24	21	6	30	26	14	20	141	1
National Insurance	38	28	3	12	30	3	4	118	2
Oriental Insurance	12	9	3	16	13	51	5	116	3
New India Assurance	6	6	8	15	60	10	3	108	4

Source: Compiled and Calculated from Capitaline Database.

Table 1 Shows the Composite Liquidity Index score and the overall ranking of the Public Health Insurance Companies in India. The Public Health Insurance Companies are classified into two categories. Liquid and less liquid taking as median score 5. The highest Composite index score has been 141, secured by United India Insurance Company and the lowest composite index score has been 108, secured by the New India Insurance Company.

DETERMINANTS OF LIQUID AND LESS LIQUID COMPANIES

Select Insurance Companies are compared with median to distinguish the liquid companies from less liquid companies. The median of the determined composite liquid index is 5 in the study period from 2019 to 2020. Table 2 shows that the sectors rank between 1st and 2nd are considered as Liquid Companies and the remaining companies between 3rd and 4th ranks are considered as Less Liquid.

Table 2
Liquid and Less Liquid Sectors

Liquid Sectors	Rank	Less Liquid Sectors	Rank
United India	01	Oriental Insurance	06
National Insurance	02	New India	07

Table 3Top Public Health Insurance Company

Top Three Sectors	Z- Score	Rank
United India	141	01
National Insurance	118	02
Oriental Insurance	109	03

Table 4Least Score Public Health Insurance Company

Least One Sector	Z- Score	Rank

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New India Assurance	108	08

Table 3 and 4 shows the composite liquidity index analysis of Public Health Insurance Companies in India during the period from April 2019 to March 2020. The composite liquidity index shows that the United India, National Insurance and Oriental Insurance Companies are the liquid companies and New India Insurance Company has the less liquid insurance company in India

Compound Annual Growth Rate of Public Health Insurance Companies in liquidity ratios(In Percentage)

Liquidity Ratios	United India Insurance	New India Insurance	Oriental Insurance	National Insurance
FANR	-0.22	0.06	**0.25**	-0.05
CANR	0.00	0.01	**0.02**	-0.08
WCR	0.02	**0.10**	0.06	-0.04
CATR	0.03	**0.11**	-0.03	0.08
FATR	-0.15	-0.10	-0.22	-0.02
NPTAR	0.04	0.08	**0.38**	0.00
DPTIR	-0.04	0.04	**0.13**	0.08

Source: Compiled and Calculated from the data Published by Capitaline Database

Table shows the compound annual growth rate of liquidity ratios of select insurance companies in India during the study period of April 2019 to March 2020. The high growth rate of fixed and current assets net worth of Oriental Insurance Company compared to other three companies 0.25 per cent and 0.02 per cent. The future growth of working capital ratio is high in United India Insurance Company with 0.10 per cent, when compared to other three companies. It is a significant growth of an institution. The high investment and the earnings of the company have increased to the growth rate of 0.38 per cent. The dividend increase rate compares to the total investments has also increase in the United India Insurance Company with 0.13 per cent.

Findings

Growth of Liquidity Ratios

The high growth rate of fixed and current assets net worth of oriental Insurance Company was compared with other three companies 0.25 per cent and 0.02 per cent. The future growth of working capital ratio was high in United India Insurance Company as 0.10 per cent. The high investment and the earnings of the company have increased to the growth rate of 0.38 per cent and the dividend increase rate compared to the total investments has increased in the United India Insurance Company has 0.13 per cent.

Results of Hypotheses Testing

➢ There is a significant impact between net profit profitability and liquidity position of Public Health insurance companies in India.

Conclusions

In compound annual growth rate of profitability the United India Insurance Company shows a high percentage and this is followed by New India Insurance Company. The compound annual growth rate of Oriental Insurance Company and National Insurance Company are almost the same.

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A Multidisciplinary & Multilingual Book on
Innovative Best Practices in 21st Century
(Opportunities & Challenges)

Editors

Dr. Devendra N. Vyas
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CONTENTS

A study on Performance Analysis of Health Insurance Companies in India

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Abstract

"Health insurance is an insurance against loss by illness or bodily injury. It provides coverage for medicine, visit to doctor or emergency room, hospital stays and other medical expenses. Policies differ in respect what they cover, the size of deductible and/or co-payments, limit of coverage and the option for treatment available to policyholders". Man can live without education and without luxuries like a big bungalow or an extravagant Car but cannot afford to live without proper health. When we talk of people living below poverty line, it becomes all the more important. For a common man who cannot afford to get quality medical treatment when he falls sick, some alternatives have to be found. Therefore it is imperative that he has to avail health insurance scheme which is the only mechanism that would meet his needs at the appropriate time of his need.

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A Revisit on Employee engagement

Amirtham.PL[1] and Dr. Satheesh Kumar.T[2]

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Abstract

Employee engagement has become a hot topic in current years. There remains a lack of precarious academic literature on the subject, and relatively little is known about how employee engagement can be influenced by management. There is a great pact of interest in engagement, there is also a good deal of misperception. At present, there is no reliability in definition, with engagement having been operationalized and measured in many disparate ways. Motivated and engaged employees incline to contribute more in terms of organizational productivity and support in maintaining a higher commitment level prominent to the higher customer satisfaction.This literature survey examined peer-reviewed journal articles, working papers, textbooks, and other published resources relevant to employee engagement. Articles were found through the search facility of on-line journal databases.

KEYWORDS: Employees, engagement, performance, satisfaction, pay and Benefits.

Introduction

The concept of employee engagement is an extent of how happy employees are with their respective jobs, working environment and how effective their performance levels are? Managing high morale among employees can be of extraordinary benefit to any organization, as keenly engaged workers are more productive and stay trustworthy to the company. Organizations with high employee engagement levels are more productive and more profitable than those organizations with low levels of employee engagement

Employee engagement

Goyal, Shipra(2019)showed an realistic proof that acceptance of employee satisfaction was expressively influenced in Deloitte financial company by all recognized variables of employee engagement "Work Environment, Quality of Work Life, Organisational Culture & Leadership Quality" had positive influence with significant effect on "Employee Satisfaction" and gives us an understanding about the employee engagement levels in financial sector companies in India.

Das, Prashant(2018) revealed that the relationship between all the variables considered and it may have practical significance to perform talent retention. Management of employee turnover and its associated costs can be improved by developing retention plans that lead to

considerable benefits for the organization such as a decline in intention to quit and retention of human intellectual capital in this global competitive knowledge economy.

Employee engagement has a positive relationship with various areas of job satisfaction, namely: career development, compensation and benefits, relationship with management, and work environment. (Michelle, and Rabo, 2018).

Saloni Devi (2017)observed that organizations' with higher levels of employee engagement outperform their competitors in terms of profitability. Engaged employees can help the organization achieve its mission, execute its strategy and create important business results. They give their companies vital competitive advantages—including higher productivity, customer satisfaction and lower employee turnover.

Employee Engagement has positive relationship with Job Satisfaction. But there is no significant relationship was found between Employee Engagement and Employee Motivation. The study also explained that there is a gender difference in the opinion of faculty members for Employee Engagement and Employee Motivation but no difference was found for Job Satisfaction. (Jaiswal, Pathak and Kumari, 2017).

SapnaPopli, Irfan A. Rizvi (2016) study highlighted the importance and the significant role of employee engagement and the role leadership styles play in emerging a culture of engagement. Suitable leadership styles and human resource (HR) practices that drive engagement essential to be adopted in organizations to drive performance.

Organizations which score high on implementation of employee engagement strategies have a lower attrition rate. (Rabiya and Sange, 2015).

Employees can be engaged sincerely and subjectively. Employees can be locked in on one measurement and not the other. Still, the more connected with the employee is on each measurement, the higher his or her general individual commitment.(Dhanalakshmi and Gurunathan, 2014).

Organizational Performance

Dr. BhatIrshad Ahmad, Prof. BharelShailendra Kumar, M Mallaohd Rafi(2018) results indicated a statistically significant relationship as well as reveals organizational strengths and areas for enhancement. The consequences of this study include the need for different service sectors to determine high level of commitment to employees for performance enhancement.

SeyedAbdorrezaPayambarpour, Lai Wan Hooi(2015) revealed employee engagement has a positive and significant effect on organisational performance. In this respect, there is consent of opinion among academicians and practitioners on high levels of engagement are

connected with high levels of performance. Our finding agrees with the views of Bakker and Schaufeli (2008), Fleck et al. (2010), and Soane (2013) that the concept of employee engagement has an effect on organisational performance.

Catherine Truss,AmandaShantz,EmmaSoane,KerstinAlfes &Rick Delbridge(2013) challenged the opinion that engagement can consistently be a 'win–win' scenario for both employees and employers as the micro-level portrayal of engagement within the wider organizational context leadsto ideological divide, power relationships and related constraints experienced in 'doing' engagement and 'being' engaged.

The principle of employee engagement is vague and confusing among both business practitioners and academic researchers. The concept is broadly useful to present behaviors, traits, psychological states, and their antecedents and results (Macey and Schneider, 2008).

Employee engagement is a critical component of individual and organizational success. It forecasts employee outcomes, organizational success, and financial performance. The impact of engagement (or disengagement) can manifest itself through productivity and organizational performance, outcomes for customers of the organisation, employee retention rates, organizational culture, and advocacy of the organisation and its external image (Schaufeli and Bakker 2008)

Lebans&Euske (2006) delivered a set of definitions to illustrate the concept of organizational performance: Performance creates both financial and non-financial indicators which offer information on the degree of achievement of objectives and results

Pay and benefits

Hyo SunJung[1]Hye HyunYoon(2015)results showed that employees' benefits, pay level, and pay structure had a significant effect on employees' job engagement, while employees' pay structure, pay level , pay raise , and benefits affected employees' job withdrawal.

ChidiebereOgbonnaya ,Kevin Daniels and Karina Nielsen(2017) results concerned that work intensity and individual-based incentive pay should give managers pause. In some situations, performance-related pay may be experienced as a problem that only provides extra pay for workers through a growth of the work process. This raises critical questions regarding the level to which individual-based incentives can affect employee well-being in a sustainable way.

Duncan Brown, Peter Reilly (2013) argued that engagement and its links with pay and rewards need to be defined and understood in each Study highlighted the importance of a total rewards approach in engaging the diversity of the workforce and gathering the wide variety of employee needs. On survey results, concluded with the depression having widened the "say–do" gap on employee engagement.

Job satisfaction

Preethi Thakur (2014) concluded that there is a positive relationship between employee engagement and job satisfaction in IT sector. Further concluded that former motivation in work can be improved through increasing job authority and accountability also includes clerical level rewards and sanctions are significantly associated with job involvement.

Reeshad S. Dalal,MichaelBaysinger ,Bradley J. Brummel ,James M. LeBreton (2012) results indicated that the best analysts of overall employee performance were trait negative affect on employee engagement, and job satisfaction. Moreover, the results were unaffected by the removal of a few behavioral items (akin to OCB) from measures of employee engagement.

Sandra Penger ,MatejČerne(2014)The hierarchical linear modeling analysis confirmed a positive relationship between authentic leadership, employees' job satisfaction, and work engagement. In addition, the relationship between authentic leadership and job satisfaction is fully mediated by perceived supervisor support, whereas also found support for partial mediation of perceived supervisor support in the relationship between authentic leadership and employees' work engagement.

Olivia Fachrunnisa, ArdianAdhiatma ,Mutamimah(2014) results showed that encouraging employee job satisfaction and performance, engagement between leader and member is significant. Specifically, our results suggested that spiritual leadership has the capacity to positively influence workplace spirituality which means employee well-being, an important element that affects creative outcomes and performance. However, managers are likely to find differences in the extent to which service employees wish to be influenced in their desire to perform and engage with leader in the workplace.

Leon T de Beer,MariaTims, Arnold B Bakker(2016) concluded, that study provided psychometric proof for the factor structure and reliability of the job crafting scale. Job crafting was positively associated to work engagement and job satisfaction in the mining and manufacturing industries. Findings suggested that supporting and enabling employees to craft their jobs by increasing their challenging job demands and resources (but not decreasing impeding job demands) may have a positive influence on both work engagement and job satisfaction.

Work environment

Bridgette Hernandez,Bettina Stanley &LaDeitrich Miller(2014)Burnout and employee disengagement are common incidences in the social work field. Many leaders trust improving job engagement will mitigate burnout. However, after a review of the literature, believedthat mediating burnout is not as simple as engaging the employee. By providing managers and leaders of social work organizations with commendations to reduce burnout and increase employee engagement and job embeddedness.

Job Performance

Kimberley Breevaart , Arnold B. Bakker , Evangelia Demerouti , Machteld vanden Heuvel (2015) concluded that Employees in high-quality Leader-member exchange(LMX) relationships work in a more resourceful work environment (i.e. report more developmental opportunities and social support, but not more autonomy). This resourceful work environment, in turn, facilitates work engagement and job performance.

Hussein Nabil Ismail, Adnan Iqbal, Lina Nasr (2019) findings showed a significant positive effect of employee engagement on job performance. However, mediation analysis using bootstrapping methods has shown that creativity has fully mediated the relationship between engagement and performance.

Conclusion:

Employee engagement is connected with the emotional, cognitive and physical aspects of work and how these factors integrated. The concept of employee engagement should not be regarded just another HR strategy. Employee's engagement is a long term process and related to core occupants of the business like as, values, culture and managerial philosophy. Employees require to be implementing in a working environment which will lead them to display behavior that organizations are viewed. An organization has to promote the factors which have a positive effect of engagement through every business activity that they do.

After reviewing research, it can also be concluded that high levels of employee engagement may lead to enhanced employee commitment & involvement towards respective jobs and thus generating a motivated workforce – that will work together to attain the common goals of the organization

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Retention factors as predictors of the job embeddedness

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Abstract

The worldwide economy is becoming progressively knowledge driven, and intellectual capital is now considered as a human resource that offers organizations a competitive advantage. A high turnover level and retention of workforce are concerns that have resulted in added interest in emotional variables, such as job embeddedness and job motivation that may influence employee retention. The objective of the study is to determine whether employee satisfaction with retention factors significantly forecast their job embeddedness. Retention factors such as Training and Development, Job motivation, Rewards and Recognition, Repatriation are the factors chosen from reviews.

Keywords: Job embeddedness, Job motivation, Retention, Rewards and Recognition, Repatriation

Introduction

Job embeddedness is the gathering of forces that affect employee retention. It can be discovered from turnover that significance is imparted to all of the aspects that retain an employee on the job, rather than the psychological process one goes through while quitting. The scholars who familiarized job embeddedness described the concept as consisting of three key components (links, fit, and sacrifice), each of which are significant both on and off the job.

Mitchell, et al., (2001) first introduced the concept of job embeddedness in their job turnover which has traditionally been assumed to relate to job satisfaction or dissatisfaction. If someone trusts that another job has more factors of satisfaction and fewer of dissatisfaction than their current role, and if their organizational commitment is low, then they're likely to leave the organization. However, the researchers say that this is only partially true. The reality is that many features influence the employee to stay with an organization, and job embeddedness deals with some of these.

Shehawy,, Elbaz ,& Agag(2018) empirically tested a complete model of job embeddedness with its drivers and assessed its impact on both organizational commitment and intention to leave. Such findings hold significant inferences for tourism small- and medium-sized enterprises in the Middle-Eastern and North-African region.

Felps et al.,(2017) developed and confirmed a model of turnover contagion in which the job embeddedness and job search behaviors of coworkers influence employees' decisions to quit. Results suggested that coworkers' job embeddedness and job search behaviors play serious roles in elucidating the reasons for people to quit their jobs.

Takawira , Coetzee ,& Schreuder (2014) study of Correlational analysis revealed substantial relationships between job embeddedness, work engagement and turnover intention. Multiple regression analysis revealed that organizational links and dedication significantly and negatively forecast turnover intention. While designing retention strategies, management and human resource practitioners need to identify how job embeddedness and work engagement inspire the turnover intention of higher education staff.

Robinson et al., (2014) indicated that a six factor solution is the best clarification. Challenging a model of the embeddedness-commitment and embeddedness-turnover relationship, the embeddedness extents of organizational sacrifice and community links displayed a positive relationship with organizational commitment. A negative relationship was found between organizational sacrifice and intentions to leave, while a positive relationship was found between community links and intentions to leave. One inference for hospitality managers is that there is a chance for hotel organizations to increase the job embeddedness of their employees by increasing the perceived costs of leaving.

Dyk, Coetzee, & Takawira (2013) concluded that the findings may be utilized as a basis for solicitous relationships between the satisfaction of valuable, scarce-skilled employees' retention factors, and their sense of job embeddedness, in order to enlighten the formulation of effective retention strategies in the South African organizational context.

Employees Retention

Employee retention includes various stages taken to retain an employee who needs to move on. An employee must discover his job as challenging and as per his interest to excel at work and stay with the organization for a longer period of time. For an organization to do well and get profits, it is vital that the high prospective employees stick to it for a longer period and contribute efficiently.

Kwenin, Muathe, & Nzulwa (2013) identified that employee job satisfaction also specified a strong signal for retention. Consequently, the study suggested that management of the organization provides intrinsic values in the jobs to make them more satisfying for the employees to stay. Human resources policies was also framed to connect directly with retention, and is thus recommended that the company takes a second look at its policies to endorse growth and opportunities for employees. Finally, the study also recommended that future research be absorbed towards examining how variables like work/life balance, organizational commitment, supervisor support, and work environment can influence employee retention and to expand the possibility to cover other telecommunication industries like MTN, TIGO, EXPRESO and AIRTELL in Ghana.

Milman & Ricci (2004) determined that hourly employees' retention was foreseen by self-fulfillment and working conditions rather than monetary rewards. More specifically, hourly

employees were likely to stay with their current employer for the next 12 months, were not involved in finding another job, had a positive experience with their lodging facilities' policies, were fulfilled with their current job, attributed a higher level of significance for paid vacation, and had a positive experience with concern to their employer's humane approach to employees

Job Motivation

Motivation is an influential energy that initiates and stimulates employees, which elicits paramount contribution. Setting and achieving goals, discernible anticipation, acknowledgment, opinion, as well as inspiring management all contribute to an increase in workplace motivation. It flourishes in an optimistic work environment, which is the purpose of many leaders wanting to learn fresh methods to motivate their workforce.

Clark & Saxberg (2019) research suggested that managers can do more to detect problems in the motivation of employees. When motivation goes off the barriers, identifying exactly which trap has fascinated the employees, and applying just the right targeted reinforcement can get things moving again.

Bryson & White (2019) construed that the returns to small-firm investments in HRM are U-shaped. Firms can renovate positive motivation when they spend intensively in HRM practices in a way that describes high performance work systems (HPWS). Although the HPWS' effect on employee motivation is altered slightly by the Great Recession. It remains robust and continues to have positive promises for small firms.

Hitesh Kumar (2017) examined the impact of organizational commitment and work motivation on job satisfaction. He ascertained that organizational commitment results in work motivation and also Job satisfaction partially. The study had inferences for educational managers, planners and institutional advisors for designing plan and programs proposed at enhancing organizational commitment, work motivation and job satisfaction of the teachers.

Training and Development

Training indicates a process of upgrading an individual's knowledge, skills and competencies. When an employee joins the organization, he/she is specified about job-related training to guarantee satisfactory performance of the responsibilities and duties allotted, so that the employee can contribute more to the organization for long term period.

In further words, transfer of knowledge established during the training must take place efficiently to realize the full benefits (*Dirani, 2012*). According to *Gegenfurtner (2011)*, one of the vital elements of transfer of knowledge is motivation to transfer. According *to Haines et al.* (*2010*), training is one of the definite human resource designs that is directly related to turnover level.

Rowold (2008) identified that training is a constructive factor. It may not be the main cause of employee satisfaction but on the contrary he found in his empirical study that training was definitely designed to achieve an explicit goal as well as job satisfaction. *Chiaburu and Lindsay (2008)* argue that providing training which is job-relevant can help organizations predict future effectiveness of employees.

Hitt et al. (2001) have initiated that training outlay firstly produces a negative effect on outcomes and the organization will not enjoy positive effects until the knowledge is transmitted. Training alone is not satisfactory to enhance organizational effectiveness to a greater level because not all the knowledge gained from the training is accurately transferred and useful to the organization.

Trevor (2001) has reasoned that the market signaling theory projected by Spence (1973) is reliable with the view that training provided by the employer has unplanned effect by increasing a person's external marketability and capacity to leave the employer. Obviously, steps are required by the employers to ensure that their investment in training is substantial and the knowledge needs to be transformed and applied in the organization before the employees leave the company.

Isyaku (2000) outlines Training and development as a progressive instrument to acquire more facts and develop new talents and methods to function effectively. *Oatey (1970)* stated training as moulding employee's social, intellectual and mental ability at work place. Training is a standard driving force that facilitates the level of productivity and the growth of employee in any organization.

Reward and recognition

Recognition should be used to supplement rewards. Positive reinforcement is the most influential and effective behavior modifier known. Satisfying employees' needs, recognizing their efforts and giving them monetary and non-monetary rewards assist in the creation of the right workforce for any organization. Recognition of their exertions and boosting their morale results in increased productivity and decreased attrition rate. It is confirmed that motivated and committed workforce can change the destiny of a company. After all, human determination is the biggest contributing influence in success of any organization.

Eshun, Kwaku Duah, & Cynthia (2011) suggested that efficient motivation program stems from a combination of extrinsic and intrinsic rewards as a substitute for focusing on any particular one. Additionally, most of the intricacies managers face in motivating their employees can be excluded or reduced when myths encompassing motivation are excluded and individual differences in terms of valence, preferences, and aspirations are incorporated. Finally, improved motivation can be achieved when managers do their best to design the work situation so they become motivators themselves while at the same time exclude demotivating factors at the work place.

Studies into rewards as motivation tend to facilitate two schools of opinions with reference to extrinsic and intrinsic rewards. One school of thought claimed that extrinsic rewards are more powerful and effective in accomplishing employee motivation, performance and commitment *(Angle & Perry1983*) while the other researchers believed that intrinsic rewards are best suitable for motivating employees (*Brief & Aldag 1983).*

Walker, Churchill and Ford (1979) keenly noted that intrinsic rewards are intangible such as recognition, appreciation and praise. However, extrinsic rewards are external and tangible and replicate lower-order human needs such as food, shelter, sex and dress.

Repatriation

Repatriation generally denotes the termination of the overseas job and coming back to home country or to the country where the Headquarter is located or to the home subsidiary from where he/she was expatriated. Repatriation (from Late Latin repatriare) is the process of returning back to one's place of origin or citizenship. This comprises the process of returning refugees or soldiers to their place of origin following a war. The term may also denote to the procedure of converting a foreign currency into the currency of one's own country. The obligatory return of a person to a country where he faces maltreatment is more specifically known as refoulement. A repatriate plays a key role to attach corporate border to rest of the globe. The successful accomplishment of assignment makes it certain for corporate growth predictions.

Meuer et al.,(2019) concluded that embeddedness is a significant means of decreasing the repatriation intention of expatriates but that off-the-job embeddedness seems more vital for AEs' (assigned expatriates) rather than SIEs' (self-initiated expatriates) repatriation intention, whereas on-the-job embeddedness shows a more important role for SIEs' than for AEs' repatriation intention. Findings of the study firmly establish the concept of embeddedness in the territory of expatriation research and trigger more research on the reasons why both types of expatriates vary in their reactions to low levels of on-the-job and off-the-job embeddedness

Chiang et al., (2017) illustrate that repatriation is increasing. Specified that organizations are increasingly transferring employees on international assignments, there is a growing necessity to recognize how repatriates can contribute to the competitive advantage of MNCs. An enhanced understanding of repatriation has the prospective to not only contribute to the personal and professional progress of repatriates, but also to organizations' desiring to improve and develop effective international human resource management platforms and practices to motivate and retain one of their most treasured resources: the repatriate.

Individual repatriation results have mainly been examined in terms of job, career, and development success (*Cerdin & Pargneux, 2009*). Job success has been measured in rapports of job satisfaction (*Cerdin & Pargneux, 2009; Stevens et al., 2006; Yan et al., 2002*) and commitment (*Chi & Chen, 2007; Stevens et al., 2006; Stroh et al., 2000*).
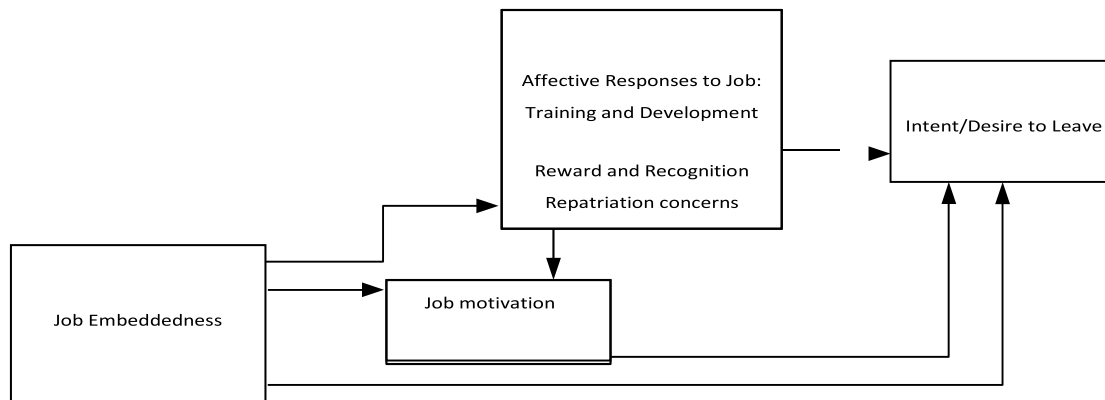
The Conceptual model for predicting employee retention

Conclusion

   Overall, it can be determined that individuals' satisfaction with organizational retention factors (training and development, Job motivation and Rewards & Recognition) significantly enhances their sense of job embeddedness. These retention factors increase the sense of job embeddedness of employees with rare skills in the organizations, and also facilitate in retaining their employees. The study contributes new knowledge to the retention literature.

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Deep Learning Methods in Classification of Myocardial Infarction by employing ECG Signals

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Abstract

Background/Objectives: To automatically classify and detect the Myocardial Infarction using ECG signals. **Methods/Statistical analysis**: Deep Learning algorithms Convolutional Neural Network(CNN), Long Short Term Memory(LSTM) and Enhanced Deep Neural Network(EDN) were implemented. The proposed model EDN, comprises the techniques CNN and LSTM. Vector operations like matrix multiplication and gradient decent were applied to large matrices of data that are executed in parallel with GPU support. Because of parallelism EDN faster the execution time of process. **Findings**: Proposed model EDN yields better accuracy (88.89%) than other state-of-art methods for PTB database. **Novelty/Applications**: The proposed classification algorithm for analyzing the ECG signals is obtained by comprising the Convolutional Neural Network(CNN)and Long short-term memory networks(LSTM). Also, it is identified that the novel classification technique based on deep learning decreases the misdiagnosis rate of MI.

Keywords: Classification; CNN; deep learning; deep neural network; EDN; LSTM; Myocardial Infarction(MI)

1 Introduction

Myocardial infarction (MI) is a life threatening cardiovascular disease caused by inadequate blood supply in myocardial for human beings. According to the survey of American Health Association, each year almost 7,20,000 people suffer from myocardial infarction[1]. Generally, manual elucidation may take time for the physician to recognize the symptoms of MI, and also it varies for time to time and patient to patient. Thus, the rapid growth of wearable computerized devices and their conceivable techniques help to save the lives of millions of people whom are getting affected by MI. Here, electrocardiogram (ECG) signals are used to identify and examine myocardial infarction in time. Three different wave forms of each cardiac cycle in ECG signals are: P wave, QRS complex, and T wave in normal rate. Nowadays, deep learning methods like convolutional neural network (CNN), recurrent neural network (RNN), auto encoder

and attention mechanism have accomplished great success in various domains, that include natural language processing, biomedical signal and image processing. Hence, the proposed algorithm based on combined CNN and LSTM (Enhanced Deep Neural Network) is used here to classify and predict whether the patient has MI or healthy.

Myocardial Infarction characteristics include ST-segment elevation, abnormal Q wave appearance, and T-wave inversion. These are commonly used for classification of feature vectors. The ECG signals are varying in ST Elevation interval length, and T waveform. In [2], a deep CNN model has been proposed to provide an effective framework for an automated detection of MI. PTB diagnostic database has been used in their experiment. In [3], CNN based multi-class MI classification model has been implemented for detecting MI by applying all 12 lead signals. This model makes the decisions through the features that are extracted from the signals. The classification model proposed in for MI detection [4] is based on Long Short Term Memory. In this system the source 8-lead ECG signals are preprocessed and partitioned into heartbeat sequences. Then these sequences are fed to LSTM network to make it learn. The features are extracted with the help of the deep learning networks in a hasty manner and that substitutes the manual method of fetching features.

Deep neural network presented in [5] can classify the 12 rhythm ECG classes. This network possesses 33 convolutional hidden layers followed by a linear output layer. Input to this network is the unprocessed ECG signal data. With this data, it learns predicts and outputs the classified 12 rhythms of each of the 256 samples. In [6], a multi-channel automatic classification algorithm has been developed by combining CNN and LSTM. Being a part of signal processing domain, ECG signal feature extraction causes more implementation difficulties and which are reduced by applying deep learning techniques. Thus, it uses CNN and LSTM for training the network. In [7], an intelligent ECG Arrhythmia Classification system using CNN has been proposed to classify the signals. Input for this network is the time series signals and output is got through its softmax layer. The signals are preprocessed and features fetched for training the network. The system perfectly classifies varying types of arrhythmia by making changes in the activation function epochs count.

RNN and GRU architecture compared with LSTM architecture is presented in [8] to obtain the best sequence model for ECG signal processing. This proposal proved that LSTM architecture has the better performance. In [9] an artificial neural network is used. In that, the parameters are modified based on the changes of ECG signals. Block-based Neural Network has been trained using PSO algorithm. The BBNNs use morphological and temporal features which have been extracted from ECG signals, and create the input vector of the BBNN. MIT-BIH arrhythmia database is used in their experiment. In [10], a deep convolutional neural network is used for automatic segmentation of psoriasis. Several deep neural architectures are trained for segmentation. A deep CNN model has been proposed [11] to provide an automatic recognition of MI.

A novel framework has been developed [12] for automatic MI detection and location. The experiment provides a new insight into the application of attention mechanism and parallel feature extraction structure based on deep learning. In [13], a deep learning method is introduced by combining CNN and RNN, and also a multi-channel CNN and LSTM network architecture is established, preprocessed ECG signals are segmented, spatial features in the multi-channel convolution network are extracted, and the temporal characteristics through LSTM are acquired. In recent years, with the development of deep learning, CNN and LSTM have achieved success. Therefore, to classify the Myocardial Infarction, this paper proposed a deep learning method combining CNN and LSTM.

2 Materials and Methods

The dataset is obtained from PTB diagnostic database. It holds 290 subjects. Each subject is denoted by three records. Each records consists of 15 signals. They are 12 conventional leads and 3 frank leads [14].

2.1 CNN

CNN is a Filtered Back Projection based artificial neural network that shares the weight. It has the connectivity resembling the biological network. CNN has pooling layer, convolutional layer, and fully connected layer [15]. The equation (1) represents the mathematical model for CNN.

$$x_j^i = f(\sum_{i \in M_j} x_i^{l-1} * k_{ij}^l + b_j^l) \tag{1}$$

From the equation (1), the input feature map is denoted by M_j; total number of layer is denoted by l; k denotes the convolution kernel; and the network bias vectors is denoted by b. During practical application, Max –pooling is frequently used. Its mathematical model is shown in the Equation (2):

$$P_i^{l+1}(j) = \max_{(j-1)W+1 \leq t \leq jW} \{q_i^l(t)\} \tag{2}$$

Here, the value of t neuron of i feature map in layer l is denoted by $q_i^l(t)$; the dimension of the pooling area is represented by W and the responding location of the neuron in layer l +1 is indicated by $P_i^{l+1}(j)$.

2.2 LSTM

The workflow of an LSTM model is shown in Figure 1. The architecture of LSTM consists of 3 gates namely input gate, forget gate and output gate.
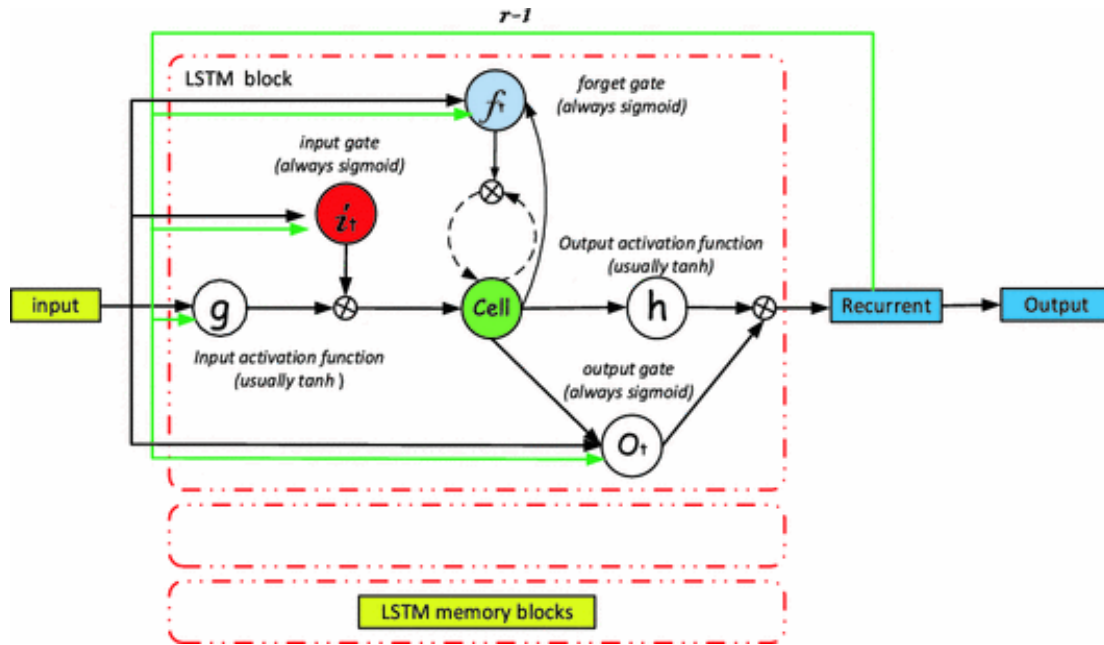
Fig 1. LSTM model

According to the above workflow diagram, the following calculation can be done in the equations (3 to 7).

$$i_t = \sigma\left(W_{xi}x_t + W_{hi}h_{t-1} + W_{ci}c_{t-1} + b_i\right) \tag{3}$$

$$f_t = \sigma\left(W_{xf}x_t + W_{hf}h_{t-1} + W_{cf}c_{t-1} + b_f\right) \tag{4}$$

$$c_t = f_t c_{t-1} + i_t tanh(W_{xc}x_t + W_{hc}h_{t-1} + b_c) \tag{5}$$

$$o_t = \sigma\left(W_{xo}x_t + W_{ho}h_{t-1} + W_{co}c_{t-1} + b_o\right) \tag{6}$$

$$h_t = o_t\, tanh\left(c_t\right) \tag{7}$$

where σ indicates sigmoid function; the input gate is represented by i_t; forget gate is denoted by f_t; and output gate is represented by o_t, c_t is the cell activation vector ; h_t in the hidden layer; and W_{ci} , W_{cf}, and W_{co} represents the weight matrix of opening connections.

2.3 Proposed Model

The LSTM unit has a memory cell to keep its state value for a long while and a gating system consisting of three non-linear gates, to point out, an input gate, a forget gate, and an output gate. The intended role of the gate's, is to regulate the flow of signals into and out of the cell, in order to be effective in regulating long-range dependencies and achieve successful RNN training. Since the inception of the LSTM unit, many modifications have been introduced to improve performance. Adding more components in the LSTM architecture may produce better performance. It is exposed in the architecture of the proposed model in Figure 2.
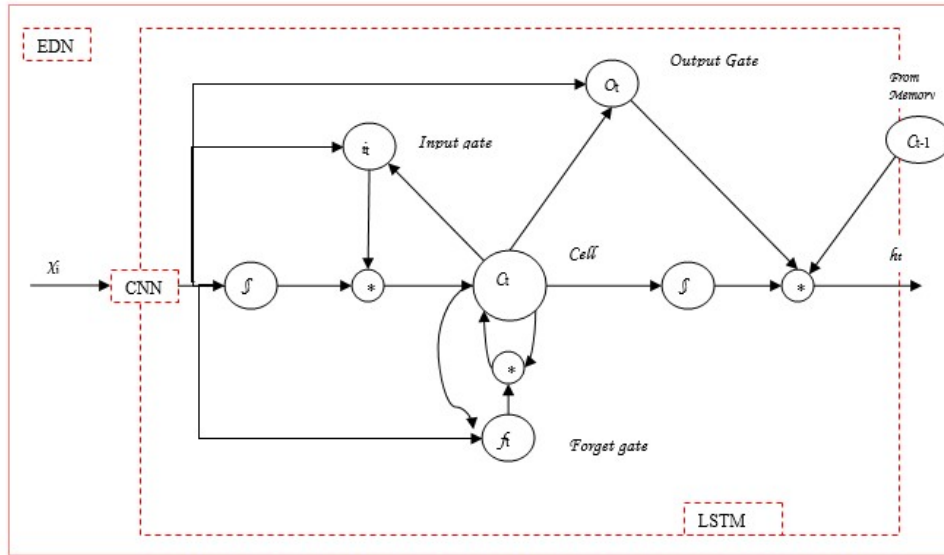
Fig 2. Architecture of proposed Model

Based on that, this study proposed an algorithm EDN based on the CNN and LSTM algorithm. In the proposed methodology, the Bias of h were added to the Cell state vector to improve the performance. As the output gate was less important than the Input gate and Forget gate. The proposed algorithm modified the Hidden state vector by adding Point wise Hadamard Multiplication among the previous Output gate parameter and previous Cell state vector. The Equation (8 to 13) represents the mathematical model for EDN.

$$x_j^i = f\left(\sum_{i \in M_j} x_i^{l-1} * k_{ij}^l + b_j^l\right) \tag{8}$$

$$i_t = \sigma\left(W_{xi}x_t + W_{hi}h_{t-1} + W_{ci}c_{t-1} + b_i\right) \tag{9}$$

$$f_t = \sigma\left(W_{xf}x_t + W_{hf}h_{t-1} + W_{cf}c_{t-1} + b_f\right) \tag{10}$$

$$O_t = \sigma\left(W_{xo}x_t + W_{ho}h_{t-1} + W_{co}c_{t-1} + o\right) \tag{11}$$

$$C_t = tanh\left(W_c x_t + r_t\left(W_c h_{t-1} + b_{ch}\right) + b_h\right) \tag{12}$$

$$h_t = (1 - o_t) * C_t + o_t * C_{t-1} \tag{13}$$

Where, x_j^i is the Input vector, which is a m-dimension vector, i_t is the Input Gate at time t, f_t is the Forget Gate at time t, vector using Sigmoid function of point wise Multiplication vectors. O_t is the Output Gate at time t. All these Input Gate, Forget Gate and Output Gate are n- Dimensional vectors. C_t is the Cell state Vector, which uses tanh activation for vector concatenation. h_t is the hidden state vector, which uses Point-wise Hadamard Multiplication operator, It is the n- Dimension activation unit for Cell State.

Algorithm EDN: Enhanced Deep Neural Network

Input : $x_i^l = (x_1^l + x_2^l + x_3^l + \cdots + x_i^l)$ - a Sequence of Independent Variables.

D – Represents the No. of memory Blocks.

S_j – Represents the No. of Cells in Block j.

Process:

Step 1: Read the data, then find out standard Deviation and separate the data.

Step 2: To obtain Total independent variable numbers.

$$Evaluate\ Mapsize\ =\ fix\ (\ \log 3 (data\ size)) - 1$$

Step 3: Set CNN layers with Input Layers and sub sampling layer.

$$\partial^L = (W^{L+l})^T \partial^{L+l}\ f(u^L)$$

$$x_j^L = f\left(\sum_{i \in M_j} x_i^{l-1} * k_{ij}^l + b_j^l \right)$$

Step 4: Pass the CNN output layers units as Input vectors to the Input gate, Forget Gate and Output Gate of LSTM unit.

Step 5: For each and every block in the Memory, compute the Input, Forget and Output gate for j=1 to D do

Evaluate the Input Gate: $i_t = \sigma(W_{xi}x_t + W_{hi}h_{t-1} + W_{ci}c_{t-1} + b_i)$

Evaluate the Forget Gate: $f_t = \sigma(W_{xf}x_t + W_{hf}h_{t-1} + W_{cf}c_{t-1} + b_f)$

Evaluate the Forget Gate: $O_t = \sigma(W_{xo}x_t + W_{ho}h_{t-1} + W_{co}c_{t-1} + b_o)$

for V =1 to S_j do

$C_t = tanh(W_c x_t + r_t (W_c h_{t-1} + b_{ch}) + b_h)$

Finally update the hidden state by computing

Evaluate the Hidden State: $h_t = (1 - o_t) * C_t + o_t * C_{t-1}$

End for

Step 6: Return EDN Layers.

The proposed EDN can process the data in a sequential manner, so that each vector in Hidden state can implicitly dependent on previous Cell State unit. EDN uses the convolutional Neural Networks to extend the effective neighborhood identification process.

3 Experimental Results

Figure 3 shows a Sample for Normal ECG and Myocardial Infarction from PTB Database.

3.1 CNN

By using Convolutional Neural Network the output is shown. Figure 4 (a) represents the framework of CNN. Figure 4(b) details the specific of each layer's parameters. Figure 5 represents Loss and Accuracy for Training and Testing data in CNN Model. Table 1 indicates Confusion Matrix for the generated model based on the testing data in CNN Model.

Table 1. Confusion matrix for the generated model based on the testing data in CNN Model

	Predicted Class 0	Predicted Class1
Class 0	175	511
Class 1	93	3235
	Accuracy	84.95%
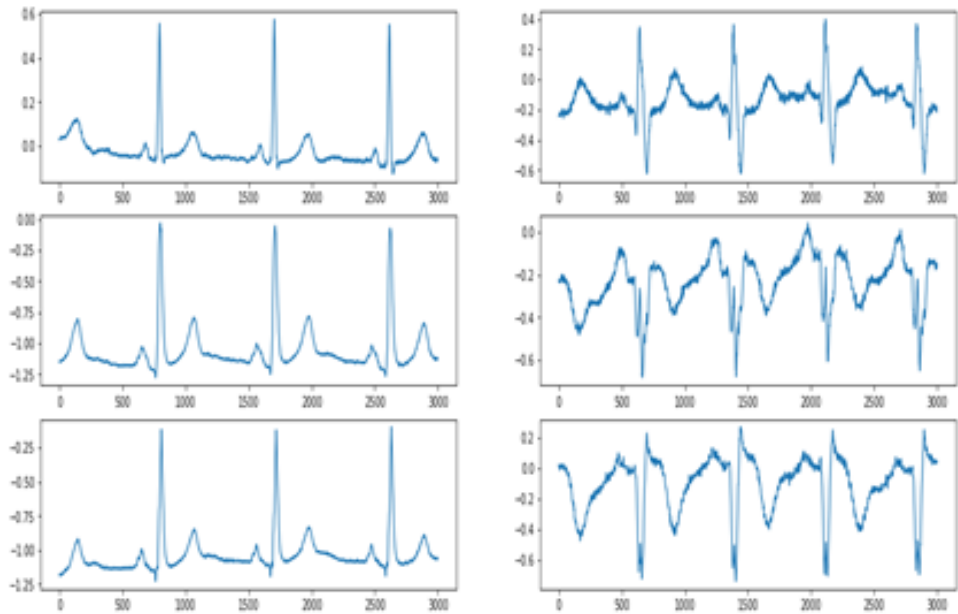
Fig 3. A Sample for Normal ECG and Myocardial Infraction from PTB Database
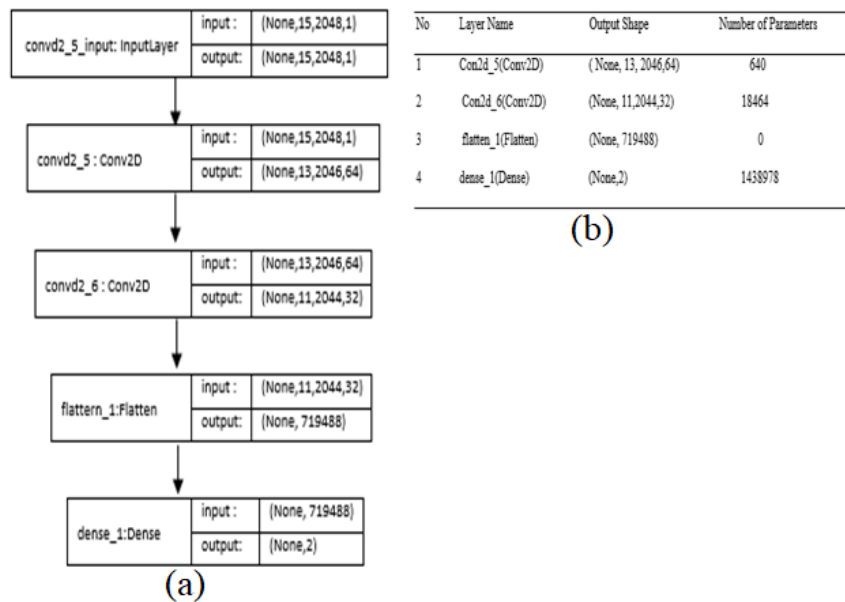
No	Layer Name	Output Shape	Number of Parameters
1	Con2d_5(Conv2D)	(None, 13, 2046,64)	640
2	Con2d_6(Conv2D)	(None, 11,2044,32)	18464
3	flatten_1(Flatten)	(None, 719488)	0
4	dense_1(Dense)	(None,2)	1438978

(b)

(a)

Fig 4. (a) Framework for CNN (b) Details of each layer's parameters of the CNN Model
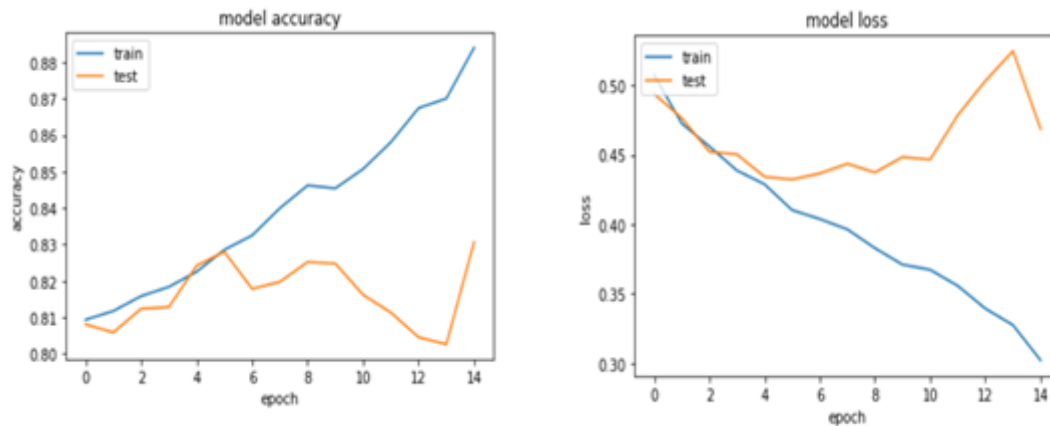
Fig 5. Loss and accuracy for Training and testing data in CNN Model

3.2 LSTM

By applying LSTM, the output is shown below. Figure 6 (a) represents the framework of LSTM. Figure 6(b) details the specific of each layer's parameters. Figure 7 shows Loss and Accuracy for Training and Testing data in LSTM Model. Table 2 indicates Confusion Matrix for the generated model based on the testing data in LSTM Model.

Table 2. Confusion Matrix for the generated model based on the testing data in LSTM Model

	Predicted Class 0	Predicted Class 1
Class 0	362	328
Class 1	212	3685
	Accuracy	85.23%

3.3 Proposed Model (EDN)

In this study, a deep learning model is created to provide high recognition performance on ECG signals based on the combination of CNN and LSTM. The 7-layer EDN model with a block representation is shown in Figure 8 (a). Healthy and MI records are feed into the input layer of this model. They go through hierarchically ordered EDN and Dropout layers and transform into feature maps of different size. In the dense layer, automatic prediction of the classes is provided. Dropout technique is used to avoid overfitting during training of the model. In each epoch, the model examines the whole training dataset. If the choosen epoch number is too large, a model can memorize the training data. Figure 8(b) details the specific of each layer's parameters.

Figure 9 shows Loss and Accuracy for Training and Testing data in proposed Model(EDN). Table 3 indicates Confusion Matrix for the generated model based on the testing data in the proposed Model(EDN).

Table 3. Confusion matrix for the generated model based on the testing data in EDN Model

	Predicted Class 0	Predicted Class1
Class 0	244	384
Class 1	118	3772
	Accuracy	88.89%

Table 4 shows the comparison of Metrics. When compared to CNN and LSTM algorithms, the performance is very high in the proposed model. Cohen Kappa Coefficient value is 0.2355, so we can conclude the proposed algorithm is working well. ROC curve is used to display the performance of classification algorithm. The precision-recall curve is plotted in Figure 10.

Figure 10 shows the performance improvisation given by the proposed EDN model when compared to the performance of existing CNN and LSTM algorithms with the same PTB dataset.

No	Layer Name	Output Shape	Number of Parameters
1	lstm_1(LSTM)	(None, 15, 256)	2360320
2	dropout_1(Dropout)	(None,15,256)	0
3	lstm_2(LSTM)	(None,15,128)	197120
4	dropout_2(Dropout)	(None,15,128)	0
5	lstm_3(LSTM)	(None, 64)	49408
6	dropout_3(Dropout)	(None, 64)	0
7	dense_1(Dense)	(None,2)	130

(b)
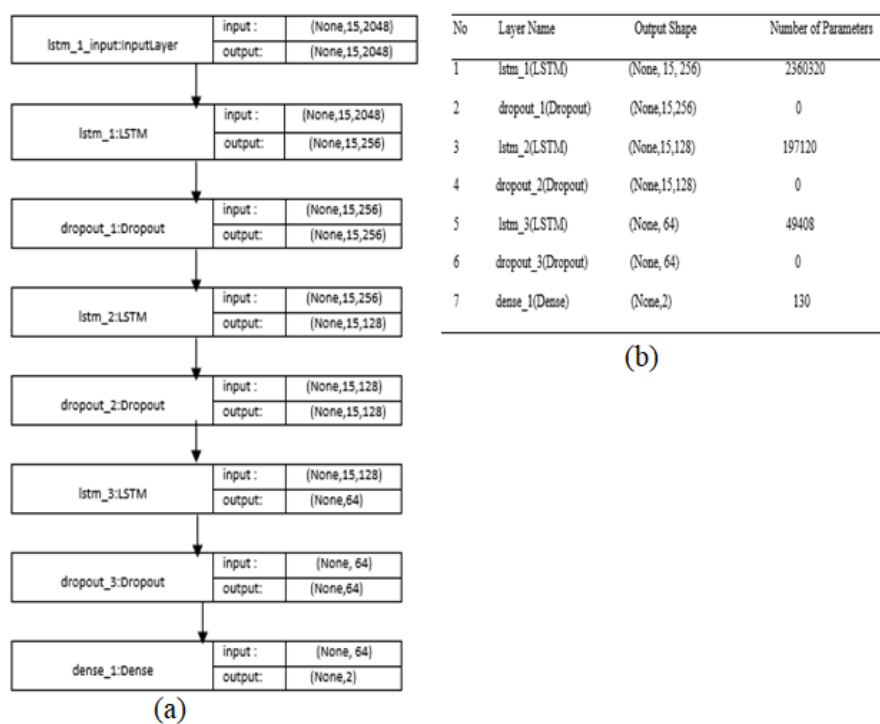
Fig 6. (a) Framework for LSTM (b) Details of eachlayer's parameters of the LSTM Model
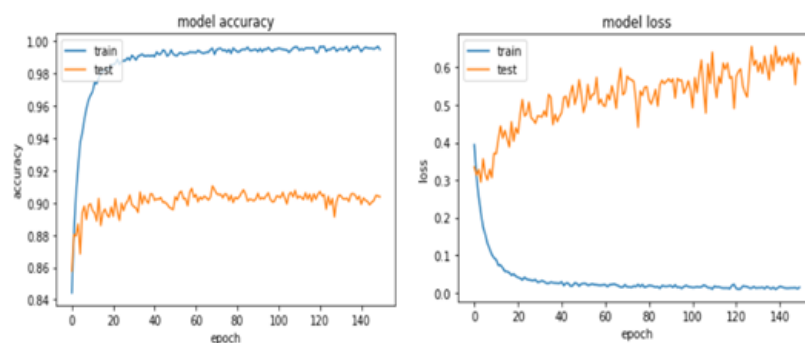
Fig 7. Loss and accuracy for training and testing data in LSTM model

Table 4. Comparison of metrics

Metrics	CNN model	LSTM model	EDN model
Precision	0.8635	0.9182	0.9776
Recall	0.7720	0.8455	0.8696
F1 Measure	0.9146	0.9217	0.9376
Cohen Kappa Coefficient	0.2996	0.5051	0.2355
Accuracy	84.95%	85.23%	88.89 %
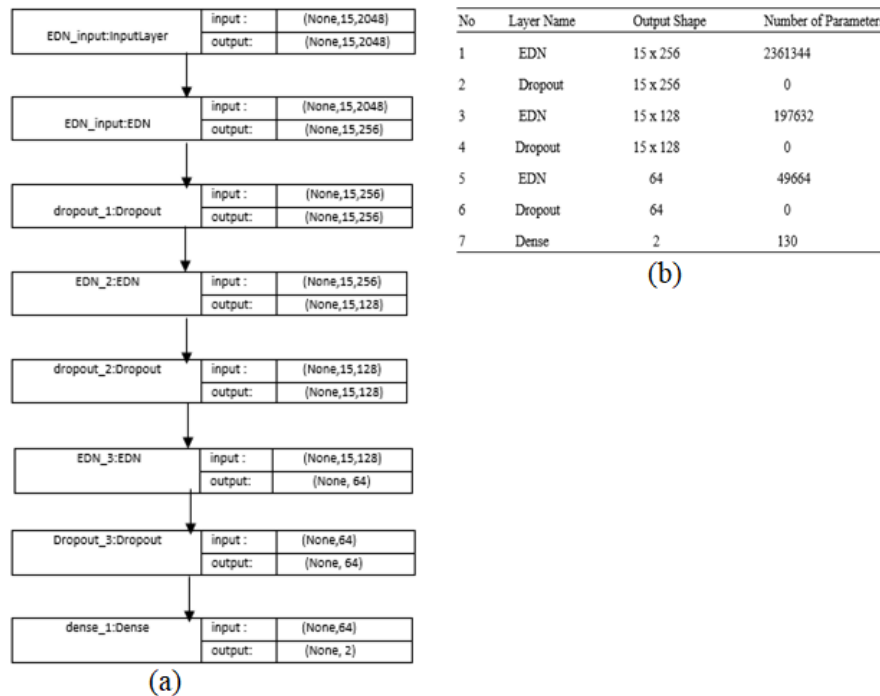
Fig 8. (a) Framework for proposed EDN (b) Details of each layer's parameters of the EDN Model
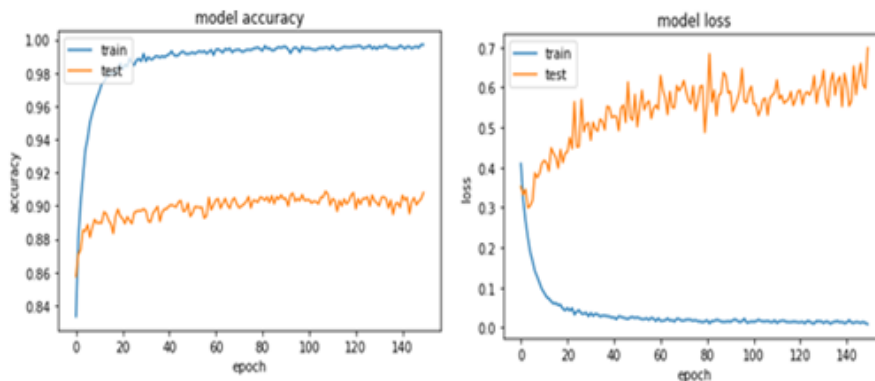
Fig 9. Loss and Accuracy for Training and Testing data in EDN Model

4 Conclusion

Going along with the direction of forward progress of the deep learning algorithms, this study proposes the EDN algorithm for classifying the ECG signals of normal and MI affected people. For demonstrating the efficiency of the proposed deep learning EDN algorithm, its performance is compared with the two most prominent algorithms of the deep learning realm namely CNN and LSTM. It is ten times faster than the LSTM due to its speed of convergence in training. Through the confusion matrices of the respective algorithms it is obvious that the EDN model achieved 88.89% accuracy; which is 3.66% and 4.04% superior than the LSTM and CNN algorithms respectively. Same way, the proposed model shows performance improvisation through the other performance metrics such as Precision, Recall, F1 measure, and Cohen Kappa Coefficient. Although the difference is small, in healthcare sectors this difference plays crucial role in saving the life of human being.
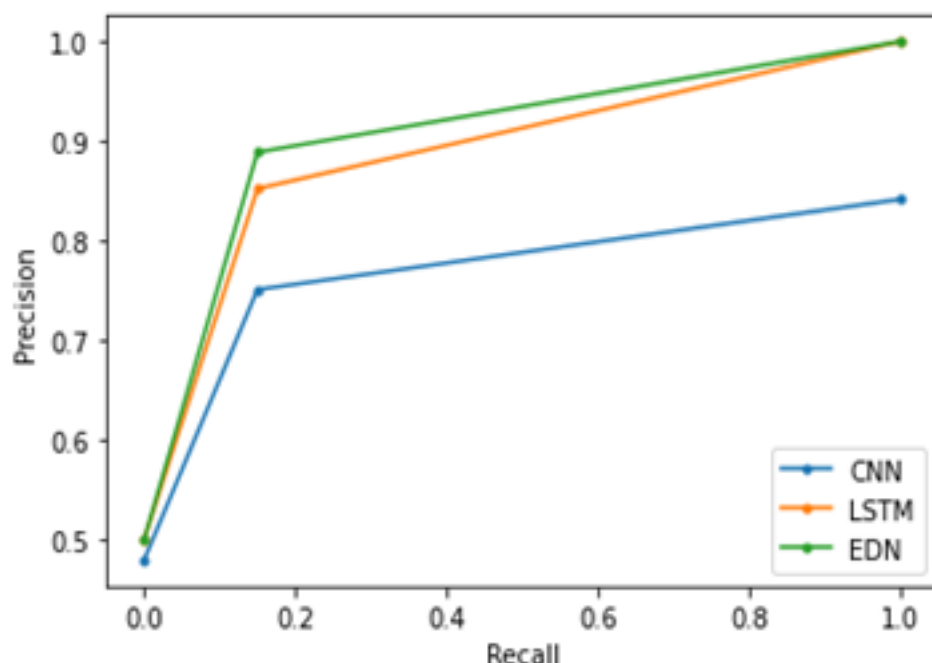
Fig 10. ROC curve

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Distribution of Temperature on a Porous Fin Exposed to Uniform Magnetic Field to a Vertical Isothermal Surface by Homotopy Perturbation Method

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Abstract :

The objective of this work is to find , the approximate analytical solution of the non-linear problem for determining the temperature distribution for porous fin which is exposed to uniform magnetic field to a vertical isothermal surface is obtained by Homotopy Perturbation Method(HPM).The formulation of the Darcy's model of heat transfer equation is considered here. To express the thermal performance, an insulated tip of finite-length fin is investigated. The effect of Rayleigh Number (Ra), Convection-conduction parameter (NC), Surface-ambient radiation parameter (Nr) and Hartman parameter (H) on the dimensionless temperature distribution are discussed. The obtained results are compared with the numerical solution.

Key words:

Non-linear problem, Porous fin , Homotopy Perturbation Method(HPM),Numerical solution.

1. INTRODUCTION

Fins are surfaces that extend from an object to or from the environment by increasing convection. It is used to improve the dissipation of heat exchangers. Usually, the surface area of the fins is made by thermal conductivity material of high rate of heat transfer. The main object of many engineering applications is that to magnify the heat transfer by the reduction of size and expense of fins. Fins are used in super heaters, conventional furnaces, gas turbines, electrical devices like motors and transformers, heat exchanging devices such as radiators in cars, computer CPU heat sinks and power plants. In Newer technology, it is also used in hydrogen fuels.

More specifically, porous fins are commonly used in many applications to improve the effective area through which the flow is infiltrate. For example, the convective flow through porous media is mandatory for many thermal engineering applications. Numerous numerical and analytical revisions has been done for understanding the transport system of the heat transfer inside the porous media.

Magnetohydrodynamics(MHD) or Magneto-fluid dynamics is the study of the magnetic properties of electrically conducting fluids. It has wide range of applications such as plasma studies, cooling of nuclear reactors, micro fluids, electromagnetic casting and crystal growth. On the effect of MHD flow, there are many studies regarding the free convection regime. But (Chamkha et al., 2004 ; Aldoss et al., 1996) studied the mixed convection regime.

In this dissertation, the temperature distribution in an insulated tip of finite length fin under uniform magnetic field is discussed.

The Homotopy Perturbation Method (HPM) was first proposed by Dr.Ji Huan He in 1998, and a systematical description was given in 2000 for solving many types of linear and nonlinear problems. This method, which is a combination of classic perturbation techniques and homotopy in

topology. It provides a convenient way to obtain approximate and analytic solution for a vast variety of problems appearing in different fields.

2. MATHEMATICAL FORMULATION

As shown in Fig.1, a rectangular porous fin profile is considered. Let the length *L*, width *W* and thickness *t* be the dimensions of the porous fin and consider the cross section area of the fin is constant. Since the fin is porous which allows the flow to infiltrate through it (Kiwan, 2007), for simplicity of the solution, the following assumptions are made to solve this problem.

The porous medium is isotropic, homogeneous and saturated with a single-phase fluid. Both the fluid and the solid matrices have constant physical properties except the density in the buoyancy term where Boussenesq approximation is used. The temperature inside the fin is only a function of *x*. The interactions between the porous medium and the clear fluid can be simulated by the Darcy formulation. In order to reduce the complexity of the problem of radiative heat flux, the porous medium is assumed to behave as an optically thick gas. A uniform magnetic field is applied in *y*-direction as depicted in Fig.1. It is assumed that the induced magnetic field, the imposed magnetic and electrical fields, and the induced electrical field due to polarization are negligible.
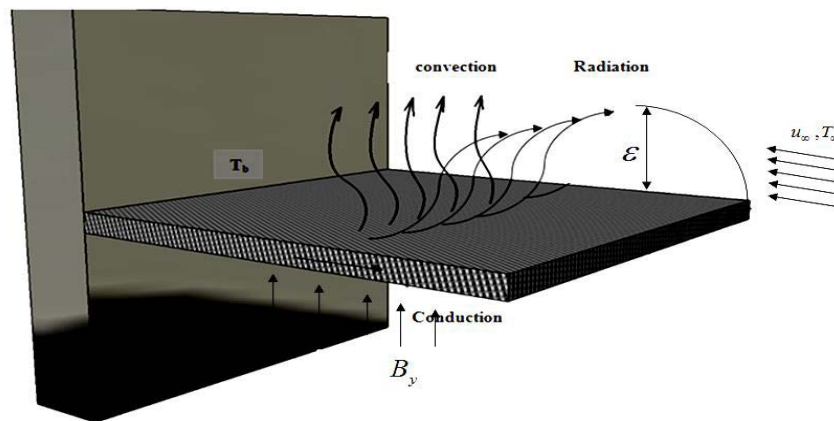
Fig.1. Schematic diagram for the problem under consideration.

Now applying energy balance equation at steady state condition to the slice segment of the fin of thickness ΔX (Aklifi et al., 2010)

$$q_{(x)} - q_{(x+\Delta x)} = \overset{\bullet}{m} c_p (T_{(x)} - T_\infty) + hP\Delta x(1-\varepsilon)(T_{(x)} - T_\infty) + \frac{J_c \times J_c}{\sigma} + P\Delta x \sigma_{St} \varepsilon (T_{(x)}^4 - \frac{\sigma}{\varepsilon}T_\infty^4) \qquad (1)$$

where the conduction current intensity J_c can be explained as:

$$J_c = \sigma(E + V \times B) \qquad (2)$$

Also, the total current intensity *J* can be stated as:

$$J = J_c + \rho_\varepsilon V \qquad (3)$$

The rate of mass flow of the fluid passing through the porous material can be written as

$$\overset{\bullet}{m} = \rho \overline{\vartheta_w} \Delta x \, w \qquad (4)$$

The value of ϑ_w should be estimated from the consideration of the flow in the porous medium. From the Darcy's model we have:

$$\overline{\vartheta_w} = \frac{gk\beta}{v}\left[T_{(x)} - T_\infty\right]$$

(5)

The energy flux vector of combined conduction and radiation at the base of the fin can be expressed as

$$q_{fin\ base} = q_{conduction} + q_{radiation}$$

(6)

Using Fourier's law of conduction, the conduction term can be expressed as

$$q_{conduction} = -k_{eff}\ A_b\ \frac{dT}{dx}$$

(7)

And the radiation heat flux term is expressed using Rosseland diffusion approximation and it is given by

$$q_{radiation} = -\frac{4\sigma_{st}}{3\beta_R}\frac{dT^4}{dx}$$

(8)

Substitution of (6) to (8) in equation (1) gives

$$\frac{d}{dx}\left[\frac{dT}{dx} + \frac{4\sigma}{3\beta_R k_{eff}}\frac{dT^4}{dx}\right] = \frac{\rho c_p gk\beta}{bvk_{eff}}\left(T_{(x)} - T_\infty\right)^2 + \frac{hp(1-\varepsilon)}{k_{eff}}\left(T_{(x)} - T_\infty\right)$$
$$+ \frac{J_c \times J_c}{\sigma k_{eff} A_b} + \frac{\sigma_{st}\varepsilon}{k_{eff}}\frac{p}{A_b}\left(T_{(x)}^4 - T_\infty^4\right)$$

(9)

where

$$\frac{J_c \times J_c}{\sigma} = \sigma B_0^2 u^2$$

(10)

and the temperature difference within the flow are assumed to be sufficiently small, the term T^4 can be expressed as a linear function temperature

$$T^4 = T_\infty^4 + 4T_\infty^3\left(T - T_\infty\right) + 6T_\infty^2\left(T - T_\infty\right)^2 + \ldots \cong 4T_\infty^3 T - 3T_\infty^4$$

(11)

By introducing the following dimensionless parameters:

$$\theta = \frac{T_{(x)} - T_\infty}{T_b - T_\infty}\ ,\ X = \frac{x}{b}\ ,\ \theta_b = \frac{T_b}{T_\infty}$$

(12)

in equation (9) and using (11) we get

$$(1 + 4Rd)\theta''(x) - Ra * \theta^2(x) - Nc(1-\varepsilon)\theta(x) - Nr\theta(x) - H\theta(x) = 0$$

(13)

where,

$$Ra = \frac{gk\beta(T_b - T_\infty)}{\alpha v k_r}\ ,\ Nc = \frac{pbh}{A_b k_{eff}}$$

$$Rd = \frac{4\sigma_{st}T_\infty^3}{3\beta_R k_{eff}}\ ,\ Nr = \frac{4\sigma_{st}bT_\infty^3}{k_{eff}}\ ,\ H = \frac{\sigma B_0^2 u^2}{k_{eff} A_b}$$

(14)

where Ra is a Modified Rayleigh Number, Nc is a convection-conduction parameter, Rd is a Radiation-conduction parameter, Nr is a Surface-ambient radiation parameter, and H is a Hartman parameter.

Equation ([13]) is a second order nonlinear ordinary differential equation which is subject to the boundary conditions:

$$\theta(1) = 1 \quad , \quad \theta'(0) = 0 \tag{15}$$

3. FUNDAMENTALS OF HOMOTOPY PERTURBATION METHOD

In this section to illustrate the basic ideas of this method, we consider the following equation :

$$A(u) = f(r) , r \in \Omega \tag{16}$$

with the boundary condition of:

$$B\left(u, \frac{\partial u}{\partial \eta}\right) = 0 , r \in \Gamma \tag{17}$$

where A is a general differential operator, B is a boundary operator, $f(r)$ is a known analytical function and Γ is the boundary of the domain Ω.

A can be divided into two parts which are L and N, where L is linear and N is nonlinear. Therefore equation([16]) can be rewritten as follows:

$$L(u) + N(u) - f(r) = 0 , r \in \Omega \tag{18}$$

Homotopy perturbation structure is shown as follows:

$$H(v, p) = (1 - p) [L(v) - L(u_0)] + p [A(v) - f(r)] = 0 \tag{19}$$

In equation ([19]), p [0, 1] is an embedding parameter and is the first approximation that satisfies the boundary conditions. We can assume that the solution of equation ([19]) can be written as a power series in p, as following:

$$v = v_0 + p\, v_1 + p^2 v_2 + \ldots \tag{20}$$

and the best approximation is:

$$u = \lim_{p \to 1} v = v_0 + v_1 + v_2 + v_3 + \ldots \tag{21}$$

4. APPLICATION

In this section, the solution of equation ([13]) can be obtained by considering

$$Rd = 0.5, \varepsilon = 0.1, Ra = 0.4, Nc = 0.3, Nr = 0.2, H = 0.1 \tag{22}$$

Using ([22]) in equation ([13])

$$3\theta'' - 0.4\theta^2 - 0.57\theta = 0 \tag{23}$$

with boundary conditions

$$\theta(1) = 1, \theta'(0) = 0 \tag{24}$$

Using equation ([19]),homotopy for the equation ([23]) i

$$(1 - p)(3\theta''(x) - 3\theta_0''(x)) + p(3\theta''(x) - 0.4\theta^2(x) - 0.57\theta(x)) = 0 \tag{25}$$

Using ([24])

$$3\theta''(x) - p(0.4\theta^2(x) + 0.57\theta(x)) = 0 \tag{26}$$

Now applying the perturbed series and equating the identical powers of "p"

$$p^0 : 3\theta_0''(x) = 0 \tag{27}$$

$$p^1 : 3\theta_1''(x) - 0.4\theta_0^2(x) - 0.57\theta_0(x) = 0 \tag{28}$$

$$p^2 : 3\theta_2''(x) - 0.8\theta_0(x)\theta_1(x) - 0.57\theta_1(x) = 0 \tag{29}$$

$$p^3 : 3\theta_3''(x) - 0.4\theta_1^2(x) - 0.8\theta_0(x)\theta_2(x) - 0.57\theta_2(x) = 0 \tag{30}$$

solving (27)-(30) , the approximate solution of equation (23) is

$$\theta(x) = 0.0002098123x^6 + 0.0041667338x^4 + 0.1335190779x^2 + 0.862104376 \tag{31}$$

5. RESULTS AND DISCUSSION

In this study, the following table gives the expression for the temperature distribution through porous fin obtained by the He's Homotopy Perturbation Method(HPM), is compared with Numerical solution(S.Rezazade Amirkolaei et.al) for various values of the independent variable x in the range 0 to 1.

Step Size X	$\theta(x)$ Temperature Distribution through porous fin		Deviation of $\theta(x)$ from N.M
	HPM	N.M(S.Rezazade Amirkolaei et.al)	
0	0.862104376	0.863499231	0.001394855
0.05	0.862438200	0.863828568	0.001390368
0.10	0.863481234	0.864817090	0.001335856
0.15	0.865115385	0.866465743	0.001350358
0.20	0.867451819	0.868776261	0.001324442
0.25	0.870465646	0.871751104	0.001285458
0.30	0.874154997	0.875393404	0.001238407
0.35	0.878523376	0.879707010	0.001183634
0.40	0.883574956	0.884696500	0.001121544
0.45	0.889314594	0.890367181	0.001052587
0.50	0.895747845	0.896725096	0.000977251
0.55	0.902880987	0.903777060	0.000896073
0.60	0.910721042	0.911530658	0.000809616
0.65	0.919275798	0.919994259	0.000718461
0.70	0.928553841	0.929177056	0.000623215
0.75	0.938564580	0.939389079	0.000524499
0.80	0.949318281	0.949741203	0.000422922
0.85	0.960859408	0.961145189	0.000285781
0.90	0.973100126	0.973313764	0.000213638
0.95	0.986153406	0.986260549	0.000107143
1	1.000000000	1.000000000	0.000000000

The above table shows that the error obtained from Homotopy Perturbation Method is very less.

The graphical representation of the solution for different parameter values are obtained from Homotopy Perturbation Method (HPM), are given in the following figures.
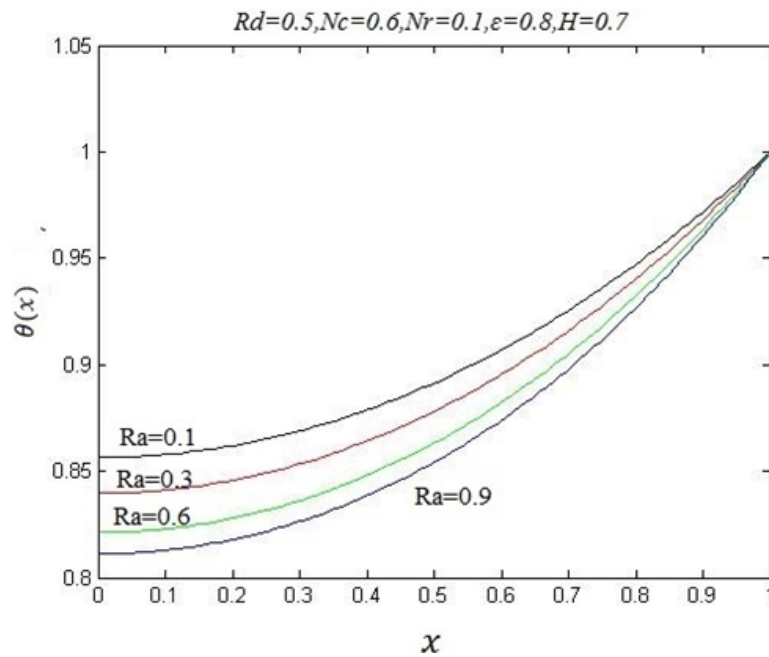
Fig 5.1. shows that when the parameter Rayleigh number(Ra) increases the temperature distribution from an insulated tip fin decreases
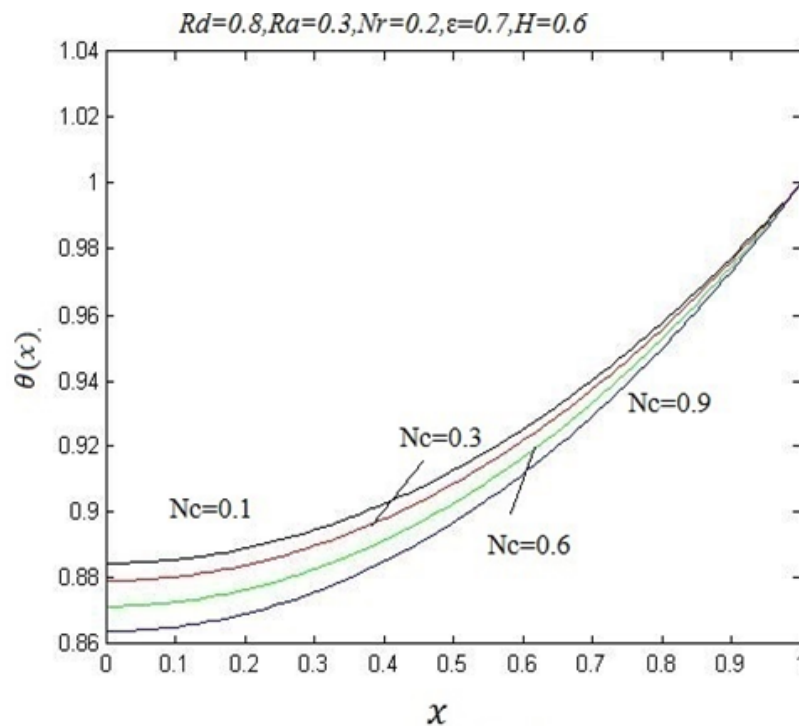
Fig 5.2.the increase in Convection-conduction parameter shows that there is decrease in the temperature distribution from an insulated tip fin.

$Rd=0.3, Ra=0.7, Nc=0.5, \varepsilon=0.2, H=0.3$
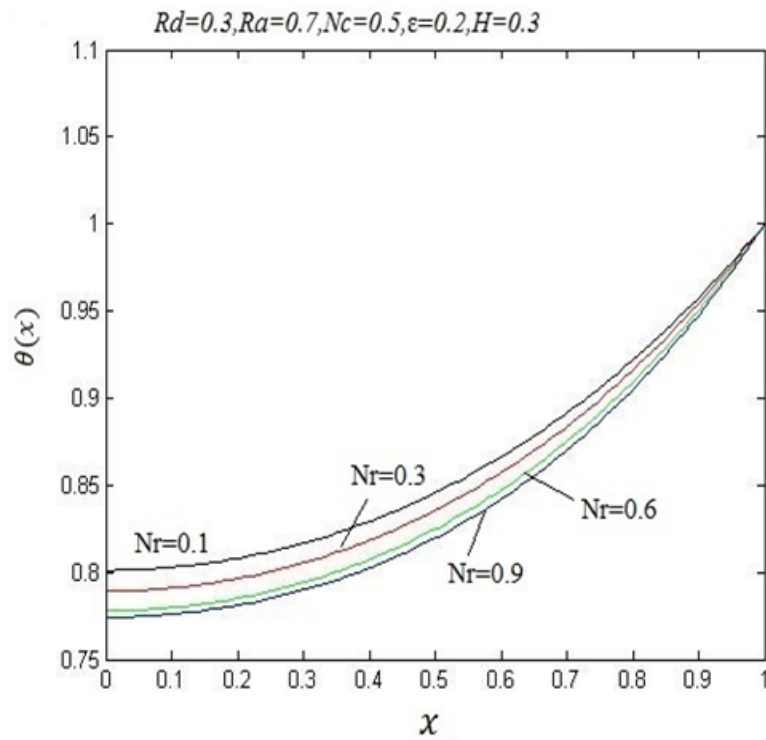
Fig 5.3 depicts that the distribution of temperature from an insulated tip fin of finite length decreases whenever the Surface-ambient radiation (Nr) parameter increases

$Rd=0.6, Ra=0.5, Nc=0.1, \varepsilon=0.4, Nr=0.7$
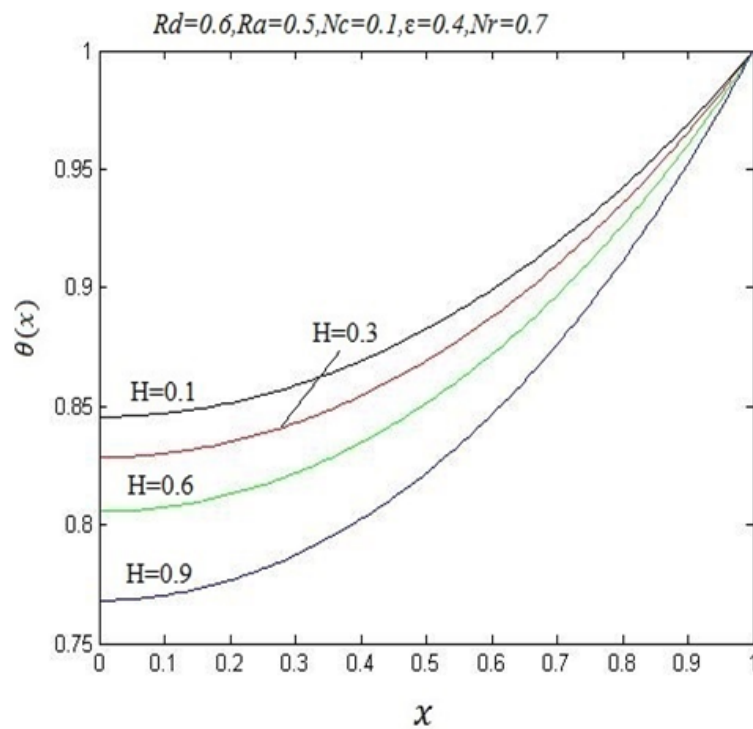
Fig.5.4.shows that the value of Hartman parameter (H) increases , the temperature distribution from an insulated tip fin decreases

6. CONCLUSION

In this paper, the Homotopy Perturbation Method (HPM)was used to find the approximate solution of temperature distribution on a porus fin exposed to a vertical isothermal surface. The results shows that the HPM is a powerful approach for solving such type of nonlinear differential equation of porous fin and the table refers that there is a good agreement between HPM and Numerical results.

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Regularity of Intuitionistic Fuzzy Soft Hypergraphs

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Abstract: An Intuitionistic Fuzzy Soft Set(IFSS) is an extension of fuzzy soft set to deal with vague information corresponding to their different parameters. The IFSS is the most efficient tool to deal with uncertain information than fuzzy soft set. Hypergraphs are used to represent almost any complex situation involving objects and a relationship among them. The concept of IFSS is applied to hypergraphs and presented the notion of Intuitionistic Fuzzy Soft Hypergraphs(IFSHGs). Further, we defined regular, totally regular and perfectly regular IFSHGs with their properties and also illustrated with its examples.

MSC: 05C72, 05C65

Keywords: Intuitionistic Fuzzy Soft Hypergraphs, Regular, Totally Regular, Perfectly Regular.
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1. Introduction

The concept of soft set theory for dealing with uncertainty from the viewpoint of parametrization was initiated by Molodtsov [7] in 1999. Maji [4] et al. introduced concept of soft set theory and extended to fuzzy soft set. The noble concept of Intuitionistic fuzzy set was introduced by Atanassov [1] in 1999. After that Maji [5] et al proposed intuitionistic fuzzy soft set as an extension fuzzy soft set. The idea of graph theory was introduced by Euler. The idea of graphs is generalized to a hypergraphs, that is, a set V of vertices together with a collection of subsets of V. In 1976, Berge [2] introduced the concept of fuzzy hypergraphs. In 2009, Nagoorgani [8] introduced regular fuzzy graphs. Parvathi [9, 10] et al. introduced the concept of intuitionistic fuzzy graphs, intuitionistic fuzzy hypergraphs. Later in 2018, regular and totally regular intuitionistic fuzzy hypergraphs were proposed by Pradeepa [11]. In 2014, Thumbakara [13] and George discussed the concept of soft graphs in the specific way. In 2015, The concept of fuzzy soft graphs was introduced by Mohinta and samanta [6]. Then intuitionistic fuzzy soft graphs were developed by several authors [3, 12]. Recently, intuitionistic fuzzy soft hypergraphs(IFSHGs) was introduced in 2018 by Thilagavathi [14]. In this paper, the concepts like Regular, Totally Regular, Perfectly Regular, Uniform IFSHGs are illustrated with examples. Also proved that an IFSHG is regular and totally regular IFSHGs if $(\mathfrak{T}_\mu, \mathfrak{T}_\nu)$ is a constant function.

Notation list

- U be the universe set and Φ be the set of all parameters.

- $\tilde{H} = (\mathfrak{N}, \mathfrak{S})$ is an IFSHGs.

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- $\langle \mathfrak{N}_\mu, \mathfrak{N}_\nu \rangle$ or simply $\langle \mu_i, \nu_i \rangle$ denotes the degrees of membership and nonmembership of the vertex $v_i \in V$, such that $0 \leq \mathfrak{N}_\mu + \mathfrak{N}_\nu \leq 1$.

- $\langle \mathfrak{S}_\mu, \mathfrak{S}_\nu \rangle$ or simply $\langle \mu_{ij}, \nu_{ij} \rangle$ denotes the degrees of membership and nonmembership of the hyperedge $v_i, v_j \in V \times V$, such that $0 \leq \mathfrak{S}_\mu + \mathfrak{S}_\nu \leq 1$.

- $P(V \times V)$ is an intuitionistic fuzzy power set.

- $P(V)$ and $P(E)$ be the set of all intuitionistic fuzzy soft set over vertices V and hyperedges E respectively.

- The support of an intuitionistic fuzzy soft set V in $\mathfrak{S}$ is denoted by $supp\mathfrak{E}_j(\phi_i) = \{v_i/\mathfrak{S}_\mu(\phi_i) > 0$ and $\mathfrak{S}_\nu(\phi_i) > 0, \phi_i \in \Phi\}$.

- $\left(\mathfrak{T}_\mu : \mathfrak{N} \to [0,1], \mathfrak{T}_\nu : \mathfrak{N} \to [0,1] \right)$ is a constant function

Throughout this paper, these notations are used.

1.1. Preliminaries

The basic definitions relating to intuitionistic fuzzy set, intuitionistic fuzzy soft set, intuitionistic fuzzy hypergraphs and intuitionistic fuzzy soft hypergraphs are dealt in this section.

Definition 1.1 ([1]). *Let a set E be fixed. An intuitionistic fuzzy set (IFS) V in E is an object of the form $V = \{\langle v_i, \mu_i(v_i), \nu_i(v_i) \rangle / v_i \in E\}$, where the function $\mu_i : E \to [0,1]$ and $\nu_i : E \to [0,1]$ determine the degree of membership and the degree of non-membership of the element $v_i \in E$, respectively and for every $\nu_i \in E$, $0 \leq \mu_i(v_i) + \nu_i(v_i) \leq 1$.*

Definition 1.2 ([9]). *Let E be the fixed set and $V = \{\langle v_i, \mu_i(v_i), \nu_i(v_i) \rangle | v_i \in V\}$ be an IFS. Six types of Cartesian products of n subsets (crisp sets) $V_1, V_2, \cdots, V_n$ of V over E are defined as follows,*

$V_{i_1} \times_1 V_{i_2} \times_1 V_{i_3} \cdots \times_1 V_{i_n} = \left\{ \left\langle (v_1, v_2, \cdots, v_n), \prod\limits_{i=1}^{n} \mu_i, \prod\limits_{i=1}^{n} \nu_i \right\rangle | v_1 \in V_1, \cdots, v_n \in V_n \right\},$

$V_{i_1} \times_2 V_{i_2} \times_2 V_{i_3} \cdots \times_2 V_{i_n} = \left\{ \left\langle (v_1, v_2, \cdots, v_n), \sum\limits_{i=1}^{n} \mu_i - \sum\limits_{i \neq j} \mu_i \mu_j + \sum\limits_{i \neq j \neq k} \mu_i \mu_j \mu_k - \cdots + (-1)^{n-2} \times \sum\limits_{i \neq j \neq k \cdots \neq n} \mu_i \mu_j \mu_k \cdots \mu_n + (-1)^{n-1} \prod\limits_{i=1}^{n} \mu_i, \prod\limits_{i=1}^{n} \nu_i \right\rangle | v_1 \in V_1, v_2 \in V_2, \cdots, v_n \in V_n \right\},$

$V_{i_1} \times_3 V_{i_2} \times_3 V_{i_3} \cdots \times_3 V_{i_n} = \left\{ \left\langle (v_1, v_2, \cdots, v_n), \prod\limits_{i=1}^{n} \mu_i, \sum\limits_{i=1}^{n} \nu_i - \sum\limits_{i \neq j} \nu_i \nu_j + \sum\limits_{i \neq j \neq k} \nu_i \nu_j \nu_k - \cdots + (-1)^{n-2} \sum\limits_{i \neq j \neq k \cdots \neq n} \nu_i \nu_j \nu_k \cdots \nu_n + (-1)^{n-1} \prod\limits_{i=1}^{n} \nu_i \right\rangle | v_1 \in V_1, \cdots, v_n \in V_n \right\},$

$V_{i_1} \times_4 V_{i_2} \times_4 V_{i_3} \cdots \times_4 V_{i_n} = \left\{ \left\langle (v_1, v_2, \cdots, v_n), min(\mu_1, \mu_2, \cdots, \mu_n), max(\nu_1, \nu_2, \cdots, \nu_n) \right\rangle | v_1 \in V_1, v_2 \in V_2, \cdots, v_n \in V_n \right\},$

$V_{i_1} \times_5 V_{i_2} \times_5 V_{i_3} \cdots \times_5 V_{i_n} = \left\{ \left\langle (v_1, v_2, \cdots, v_n), max(\mu_1, \mu_2, \cdots, \mu_n), min(\nu_1, \nu_2, \cdots, \nu_n) \right\rangle | v_1 \in V_1, v_2 \in V_2, \cdots, v_n \in V_n \right\},$

$V_{i_1} \times_6 V_{i_2} \times_6 V_{i_3} \cdots \times_6 V_{i_n} = \left\{ \left\langle (v_1, v_2, \cdots, v_n), \frac{\sum\limits_{i=1}^{n} \mu_i}{n}, \frac{\sum\limits_{i=1}^{n} \nu_i}{n} \right\rangle | v_1 \in V_1, v_2 \in V_2, \cdots, v_n \in V_n \right\}$

It must be noted that $v_i \times_s v_j$ is an IFS, where $s = 1, 2, 3, 4, 5, 6$.

Definition 1.3 ([5]). *If $M \subseteq \Phi$ and $\mathcal{IF}^U$ denotes the set of all intuitionistic fuzzy sets of U. A pair (F, M) is called an intuitionistic fuzzy soft set over U, where intuitionistic fuzzy approximation function is given by $F = (F_\mu, F_\nu) : M \to \mathcal{IF}^U$.*

Definition 1.4 ([3, 10]). *An intuitionistic fuzzy soft graph (IFSG) on a nonempty set V is an ordered 3-tuple $G = (F, K, \Phi)$ such that*

- (F, Φ) *is an intuitionistic fuzzy soft set over V.*

- (K, Φ) *is an intuitionistic fuzzy relation on V. That is $K : \Phi \to P(V \times V)$.*

- $(F(\phi), K(\phi))$ *is an intuitionistic fuzzy soft subgraph, for all* $\phi \in \Phi$.

That is,

1. $K_\mu(\phi)(uv) \leq min\{F_\mu(\phi)(u), K_\mu(\phi)(v)\}$

2. $K_\nu(\phi)(uv) \leq max\{F_\nu(\phi)(u), K_\nu(\phi)(v)\}$,

such that $0 \leq K_\mu(\phi)(uv) + K_\nu(\phi)(uv) \leq 1$, *for every* $\phi \in \Phi$ *and* $u, v \in V$.

Note: The fifth cartesian product has been used throughout this paper,

$$V_{i_1} \times_5 V_{i_2} \times_5 V_{i_3} \cdots \times_5 V_{i_n} = \left\{ \langle (v_1, v_2, \cdots, v_n), max(\mu_1, \mu_2, \cdots, \mu_n), min(\nu_1, \nu_2, \cdots, \nu_n) \rangle | v_1 \in V_1, v_2 \in V_2, \cdots, v_n \in V_n \right\}.$$

Definition 1.5. *An intuitionistic fuzzy soft hypergraphs(IFSHGs)* $\tilde{H} = (H^*, \mathfrak{N}, \mathfrak{S}, \Phi)$ *is an ordered 4-tuple, such that*

- $H^* = \langle V, E \rangle$ *is a intutionistic fuzzy hypergraph.*

- $(\mathfrak{N}, \Phi)$ *is an intuitionistic fuzzy soft set over* V.

- $(\mathfrak{S}, \Phi)$ *is an intuitionistic fuzzy relation on* V. *That is* $\mathfrak{S} : R \to P(V \times V)$.

- $(\mathfrak{N}(\phi), \mathfrak{S}(\phi))$ *is an intuitionistic fuzzy soft subhypergraph, for all* $\phi \in \Phi$.

That is,

1. $\mathfrak{S}_\mu(\phi)(x_1, ..., x_n) \leq max\{\mathfrak{N}_\mu(\phi)(x_1), \mathfrak{N}_\mu(\phi)(x_2), ..., \mathfrak{N}_\mu(\phi)(x_n)\}$

2. $\mathfrak{S}_\nu(\phi)(x_1, ..., x_n) \leq min\{\mathfrak{N}_\nu(\phi)(x_1), \mathfrak{N}_\nu(\phi)(x_2), ..., \mathfrak{N}_\nu(\phi)(x_n)\}$,

such that $0 < \mathfrak{S}_\mu(\phi)(x_1, ..., x_n) + \mathfrak{S}_\nu(\phi)(x_1, ..., x_n) \leq 1$, *for all* $\phi \in \Phi$ *and* $x_1, ..., x_n \in V$. *Where,* $\mathfrak{S}_\mu(\phi)(x_1, ..., x_n)$ *denotes the degree of membership and* $\mathfrak{S}_\nu(\phi)(x_1, ..., x_n)$ *denotes the degree of non-membership of vertex to intuitionistic fuzzy soft hyperedge* $\mathfrak{T}_j$.

Intuitionistic fuzzy soft hypergraph is denoted by $\tilde{H} = (\mathfrak{N}(\phi), \mathfrak{S}(\phi))$ *or* $\tilde{H} = \left\{ \tilde{H}(\phi_1), \tilde{H}(\phi_2), ..., \tilde{H}(\phi_n) \right\}$. *In other words, an intuitionistic fuzzy soft hypergraphs is a parameterized family of intuitionistic fuzzy hypergraphs.*

Example 1.6. *Consider an IFSHG* $\tilde{H} = (H^*, \mathfrak{N}, \mathfrak{S}, \Phi)$, *such that* $V = \{v_1, v_2, v_3, v_4, v_5, v_6\}$ *and* $E = \{S_1, S_2, S_3, S_4, S_5\}$. *Let* $\Phi = \{\phi_1, \phi_2\}$ *be a parameter set. Let* $(\mathfrak{N}, \Phi)$ *be an intuitionistic fuzzy soft set over* V *with its approximate function* $\mathfrak{N} : \Phi \to P(V)$. *Let* $(\mathfrak{S}, \Phi)$ *be an intuitionistic fuzzy soft set over* E *with its approximate function* $\mathfrak{S} : \Phi \to P(E)$. *An IFSHG* $\tilde{H} = \left\{ \tilde{H}(\phi_1), \tilde{H}(\phi_2) \right\}$ *is shown in Figure 1.*
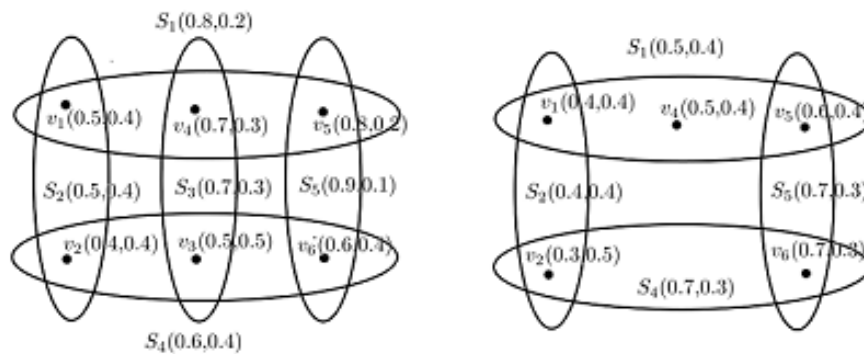
Figure 1. $\tilde{H} = \left\{ \tilde{H}(\phi_1), \tilde{H}(\phi_2) \right\}$

2. Regular Intuitionistic Fuzzy Soft Hypergraphs

Definition 2.1. *The order of an IFSHG is* $\mathcal{O}(\tilde{H}) = \left[\sum_{\phi_i \in \Phi} \left(\sum_{v \in V} \mathfrak{N}_\mu(v) \right), \sum_{\phi_i \in \Phi} \left(\sum_{v \in V} \mathfrak{N}_\nu(v) \right) \right].$

Definition 2.2. *The size of an IFSHG is*

$$\mathcal{S}(\tilde{H}) = \left[\sum_{\phi_i \in \Phi} \left(\sum_{v_1 \dots v_n \in \mathfrak{T}} \mathfrak{T}_\mu(\phi_i)(v_1 \dots v_n) \right), \sum_{\phi_i \in \Phi} \left(\sum_{v_1 \dots v_n \in E} \mathfrak{T}_\nu(\phi_i)(v_1 \dots v_n) \right) \right].$$

Definition 2.3. *The open neighborhood of a vertex $v_i(\phi_i)$ in the intuitionistic fuzzy soft hypergraph is denoted by $O_N(\phi_i)(v_1 \dots v_n)$ and it is defined by the set of adjacent vertices of $v_i(\phi_i)$ excluding that vertex corresponding to the parameter.*

Definition 2.4. *The closed neighbourhood of a vertex $v_i(\phi_i)$ in the intuitionistic fuzzy soft hypergraph is denoted by $C_N\left[(\phi_i)(v_1 \dots v_n)\right]$ and it is defined by the set of adjacent vertices of $v_i(\phi_i)$ including that vertex corresponding to the parameter.*

Example 2.5. *For the above Example 1.6, the open neighborhood of a vertex $v_2(\phi_1) = v_1, v_3, v_6$ and $v_2(\phi_2) = v_1, v_6$. The closed neighborhood of a vertex $v_2(\phi_1) = v_1, v_2, v_3, v_6$ and $v_2(\phi_2) = v_1, v_2, v_6$.*

Definition 2.6. *If $\tilde{H} = (\mathfrak{N}, \mathfrak{S})$ be an Intuitionistic Fuzzy Soft Hypergraph, then the degree of open neighborhood for a vertex $v_i(\phi_i)$ is denoted by $degO_N(v_i(\phi_i))$ and it is defined by $degO_N(v_i(\phi_i)) = \left(deg_\mu v_i(\phi_i), deg_\nu(v_i(\phi_i)) \right)$, where $deg_\mu(v_i(\phi_i)) = \sum_{v_i \in \mathfrak{N}} \mathfrak{N}_\mu(v_i(\phi_i))$ and $deg_\nu(v_i(\phi_i)) = \sum_{v_i \in \mathfrak{N}} \mathfrak{N}_\nu(v_i(\phi_i))$.*

Definition 2.7. *If $\tilde{H} = (\mathfrak{N}, \mathfrak{S})$ be an Intuitionistic Fuzzy Soft Hypergraph, then the degree of closed neighborhood for a vertex $v_i(\phi_i)$ is denoted by $degC_N[v_i(\phi_i)]$ and it is defined by $degC_N[v_i(\phi_i)] = (deg_\mu[v_i(\phi_i)], deg_\nu[v_i(\phi_i)])$, where $deg_\mu[v_i(\phi_i)] = deg_\mu(v_i(\phi_i)) + \mathfrak{N}_\mu(v_i(\phi_i))$ and $deg_\nu[v_i(\phi_i)] = deg_\nu(v_i(\phi_i)) + \mathfrak{N}_\nu(v_i(\phi_i))$.*

Example 2.8. *For the above Example 1.6, the degree of open neighborhood for a vertex $v_2(\phi_1) = (1.6, 1.3)$ and $v_2(\phi_2) = (1.1, 0.7)$. The degree of closed neighborhood for a vertex $v_2(\phi_1) = (2.0, 1.7)$ and $v_2(\phi_2) = (1.4, 1.2)$.*

Definition 2.9. *Let $\tilde{H} = (\mathfrak{N}, \mathfrak{S})$ be an IFSHG. If all the vertices in $\mathfrak{N}$ have the same degree of open neighborhood degree (k_i, k_i') for the corresponding parameters, then $\tilde{H}$ is said to be (k_i, k_i') - regular Intuitionistic Fuzzy Soft Hypergraph.*

Remark 2.10. *Any intuitionistic fuzzy soft hypergraphs with two vertices and one hyperedge is regular.*

Definition 2.11. *Let $\tilde{H} = (\mathfrak{N}, \mathfrak{S})$ be an IFSHG. If all the vertices in $\mathfrak{N}$ have the same degree of closed neighborhood degree (p_i, p_i') for the corresponding parameters, then $\tilde{H}$ is said to be (p_i, p_i') - totally regular Intuitionistic Fuzzy Soft Hypergraph.*

Definition 2.12. *Let $\tilde{H} = (\mathfrak{N}, \mathfrak{S})$ be an IFSHG. IF $\tilde{H}$ is (k_i, k_i') - regular and (p_i, p_i') - totally regular Intuitionistic Fuzzy Soft Hypergraph, then it is said to be perfectly regular IFSHG.*

Example 2.13. *Consider an IFSHG $\tilde{H} = (H^*, \mathfrak{N}, \mathfrak{S}, \Phi)$, such that $V = \{v_1, v_2, v_3, v_4\}$ and $E = \{v_1v_2, v_2v_3, v_3v_4, v_1v_4\}$. Let $\Phi = \{\phi_1\}$ be a parameter set. Let $(\mathfrak{N}, \Phi)$ be an intuitionistic fuzzy soft set over V with its approximate function $\mathfrak{N} : \Phi \to P(V)$.*

$$\mathfrak{N}(\phi_1) = \{v_1\langle 0.7, 0.3\rangle, v_2\langle 0.7, 0.3\rangle, v_3\langle 0.7, 0.3\rangle, v_4\langle 0.7, 0.3\rangle\}$$

Let $(\mathfrak{S}, \Phi)$ be an intuitionistic fuzzy soft set over E with its approximate function $\mathfrak{S} : \Phi \to P(E)$.

$$\mathfrak{S}(\phi_1) = \{v_1v_2\langle 0.8, 0.2\rangle, v_2v_3\langle 0.8, 0.2\rangle, v_3v_4\langle 0.8, 0.2, v_1v_4\langle 0.8, 0.2\rangle\}.$$

The open neighborhood degree of the vertices for the parameter ϕ_1 are same. That is, $deg(v_1) = deg(v_2) = deg(v_3) = deg(v_4) = (1.4, 0.6)$. Hence IFSHG is said to be regular of degree $(1.4, 0.6)$ (or) $(1.4, 0.6)$ - regular Intuitionistic Fuzzy Soft Hypergraph. The closed neighborhood degree of the vertices for the parameter ϕ_1 are same. That is, $deg(v_1) = deg(v_2) = deg(v_3) = deg(v_4) = (3.0, 1.0)$. Hence IFSHG is said to be totally regular of degree $(2.1, 0.9)$ (or) $(2.1, 0.9)$- totally regular Intuitionistic Fuzzy Soft Hypergraph.

Remark 2.14. *Any intuitionistic fuzzy soft hypergraphs with different membership and non-membership values need not to be regular or totally regular under parametrization.*

Theorem 2.15. *Let $\tilde{H} = (\mathfrak{N}, \mathfrak{S})$ be an IFSHG. Then $\left(\mathfrak{T}_\mu : \mathfrak{N} \to [0,1], \mathfrak{T}_\nu : \mathfrak{N} \to [0,1]\right)$ is a constant function iff the following conditions are equivalent.*

(i). $\tilde{H}$ is a regular IFSHG.

(ii). $\tilde{H}$ is totally regular IFSHG.

Proof. Suppose that $(\mathfrak{T}_\mu, \mathfrak{T}_\nu)$ be a constant function. Let $\mathfrak{T}_\mu(v_1) = \mathcal{C}_1$ and $\mathfrak{T}_\nu(v_1) = \mathcal{C}_2$ for the parameter $\phi_1 \in \Phi$ and $v_1 \in \mathfrak{T}$.

$(i) \implies (ii)$ Assume that $\tilde{H}$ is a $(k_i, k_i^{'})$-regular IFSHG. Let $deg_\mu(v_1(\phi_1)) = k_1$ and $deg_\nu(v_1(\phi_1) = k_1^{'}$. Then we have,

$$deg_\mu[v_1(\phi_1)] = deg_\mu(v_1(\phi_1)) + \mathfrak{T}_\mu(v_1(\phi_1)) \ \ and \ \ deg_\nu[v_1(\phi_1)] = deg_\nu(v_1(\phi_1)) + \mathfrak{T}_\mu(v_1)(\phi_1))$$

Thus $deg_\mu[v_1(\phi_1)] = k_1 + \mathcal{C}_1$ and $deg_\nu[v_1(\phi_1)] = k_1^{'} + \mathcal{C}_2$. Hence $\tilde{H}$ is totally regular IFSHG.

$(ii) \implies (i)$ Assume that $\tilde{H}$ is a $(p_i, p_i^{'})$-totally regular IFSHG. Let $deg_\mu[v_1(\phi_1)] = p_1$ and $deg_\nu[v_1(\phi_1)] = p_1^{'}$. Then we have

$$deg_\mu[v_1(\phi_1)] = deg_\mu(v_1(\phi_1)) + \mathfrak{T}_\mu(v_1(\phi_1)) \ \ and \ \ deg_\nu[v_1(\phi_1)] = deg_\nu(v_1(\phi_1)) + \mathfrak{T}_\mu(v_1)(\phi_1))$$

$\implies deg_\mu(v_1(\phi_1)) + \mathfrak{T}_\mu(v_1(\phi_1)) = p_1, deg_\nu(v_1(\phi_1)) + \mathfrak{T}_\mu(v_1)(\phi_1)) = p_1^{'}$

$\implies deg_\mu(v_1(\phi_1)) + \mathcal{C}_1 = p_1, deg_\nu(v_1(\phi_1)) + \mathcal{C}_2 = p_1^{'}$

$\implies deg_\mu(v_1(\phi_1)) = p_1 - \mathcal{C}_1, deg_\nu(v_1(\phi_1)) = p_1^{'} - \mathcal{C}_2$, for $\phi_1 \in \Phi$ and $v_1 \in \mathfrak{T}$.

Thus $\tilde{H}$ is a regular IFSHG. Hence (i) and (ii) are equivalent.

Conversely, Assume that (i) and (ii) are equivalent. That is $\tilde{H}$ is a regular IFSHG iff $\tilde{H}$ is a totally regular IFSHG. Suppose that $(\mathfrak{T}_\mu, \mathfrak{T}_\nu)$ is not a constant function and $\mathfrak{T}_i(v_1)$ and $\mathfrak{T}_i(v_2)$ is not equal for some $v_1, v_2 \in \mathfrak{N}$ corresponding to the parameter ϕ_1. If $\tilde{H}$ is a $(k_i, k_i^{'})$ - regular IFSHG, then $deg(v_1)(\phi_1)) = (k_1, k_1^{'})$ for all $v_1 \in \mathfrak{T}_i$. Consider,

$$deg[v_1(\phi_1)] = deg(v_1(\phi_1)) + \mathfrak{T}(v_1(\phi_1)) = (k_1, k_1^{'}) + \mathfrak{T}(v_1(\phi_1)) \ \ and \ \ deg[v_2(\phi_1)] = deg(v_2(\phi_1)) + \mathfrak{T}(v_2(\phi_1)) = (k_2, k_2^{'}) + \mathfrak{T}(v_2(\phi_1)).$$

Then $\mathfrak{T}_i(v_1)$ and $\mathfrak{T}_i(v_2)$ is not equal for some $v_1, v_2 \in \mathfrak{N}$ corresponding to the parameter ϕ_1. Thus $deg[v_1(\phi_1)]$ and $deg[v_2(\phi_1)]$ are not equal. Hence $\tilde{H}$ is not a totally regular IFSHG, which is a contradiction. Let $\tilde{H}$ is totally regular IFSHG. Then $deg[v_1(\phi_1)] = deg[v_2(\phi_1)]$. That is $deg(v_1(\phi_1)) + \mathfrak{T}(v_1(\phi_1)) = deg(v_2(\phi_1)) + \mathfrak{T}(v_2(\phi_1))$ and $deg(v_1(\phi_1)) - deg(v_2(\phi_1)) = \mathfrak{T}(v_2(\phi_1)) - \mathfrak{T}(v_1(\phi_1))$. Since $deg(v_1(\phi_1)) - deg(v_2(\phi_1)) \neq 0$ and $\mathfrak{T}(v_2(\phi_1)) - \mathfrak{T}(v_1(\phi_1)) \neq 0$. Thus $deg[v_1(\phi_1)] \neq deg[v_2(\phi_1)]$, So $\tilde{H}$ is not a regular IFSHG. which is a contradiction to our assumption. Hence $(\mathfrak{T}_\mu, \mathfrak{T}_\nu)$ must be a constant function. $\square$

Theorem 2.16. *Let $\tilde{H} = (\mathfrak{N}, \mathfrak{S})$ be an IFSHG. If $\tilde{H}$ is both regular and totally regular, then $(\mathfrak{T}_\mu, \mathfrak{T}_\nu)$ is a constant function.*

Proof. Let $\tilde{H} = (\mathfrak{N}, \mathfrak{S})$ be an IFSHG and it is both regular and totally regular. Let $deg_\mu[v_1(\phi_1)] = p_1$ and $deg_\nu[v_1(\phi_1)] = p_1'$, for all $\phi_i \in \Phi$ and $v_i \in \mathfrak{T}$. Let $deg_\mu(v_i(\phi_i)) = p_n$ and $deg_\nu(v_i(\phi_i) = p_n'$, for all $\phi_i \in \Phi$ and $v_i \in \mathfrak{T}$. Consider, $deg_\mu[v_i(\phi_i)] = p_1$, for all $v_i \in \mathfrak{T} \Leftrightarrow deg_\mu(v_i(\phi_i)) + \mathfrak{T}_\mu(v_i(\phi_i)) = p_1 \Leftrightarrow p_n + \mathfrak{T}_\mu(v_i(\phi_i)) = p_1 \Leftrightarrow \mathfrak{T}_\mu(v_i(\phi_i)) = p_1 - p_n$, for all $v_i \in \mathfrak{T}$ and $\phi_i \in \Phi$. Consider, $deg_\nu[v_i(\phi_i)] = p_1'$, for all $v_i \in \mathfrak{T} \Leftrightarrow deg_\nu(v_i(\phi_i)) + \mathfrak{T}_\nu(v_i(\phi_i)) = p_1' \Leftrightarrow p_n + \mathfrak{T}_\nu(v_i(\phi_i)) = p_1' \Leftrightarrow \mathfrak{T}_\nu(v_i(\phi_i)) = p_1' - p_n'$, for all $v_i \in \mathfrak{T}$ and $\phi_i \in \Phi$. Hence $(\mathfrak{T}_\mu, \mathfrak{T}_\nu)$ is a constant function. $\square$

Note: The converse of the theorem need not be true.

Definition 2.17. *If all the hyper-edges corresponding to their parameters have the same cardinality, then IFSHG is said to be (k_i, k_i') - uniform IFSHG.*

Example 2.18. *Consider an IFSHG $\tilde{H} = (H^*, \mathfrak{N}, \mathfrak{S}, \Phi)$, such that $V = \{v_1, v_2, v_3, v_4, v_5\}$ and $E = \{v_1 v_2 v_3, v_3 v_4 v_5\}$. Let $\Phi = \{\phi_1\}$ be a parameter set. Let $(\mathfrak{N}, \Phi)$ be an intuitionistic fuzzy soft set over V with its approximate function $\mathfrak{N} : \Phi \to P(V)$. $\mathfrak{N}(\phi_1) = \{v_1 \langle 0.5, 0.4\rangle, v_2 \langle 0.6, 0.3\rangle, v_3 \langle 0.7, 0.2\rangle, v_4 \langle 0.4, 0.3\rangle, v_5 \langle 0.3, 0.2\rangle\}$. Let $(\mathfrak{S}, \Phi)$ be an intuitionistic fuzzy soft set over E with its approximate function $\mathfrak{S} : \Phi \to P(E)$. $\mathfrak{S}(\phi_1) = \{v_1 v_2 v_3 \langle 0.8, 0.2\rangle, v_3 v_4 v_5 \langle 0.8, 0.2\rangle\}$. The $(0.8, 0.2)$ - Uniform IFSHG is shown in Figure 2.*
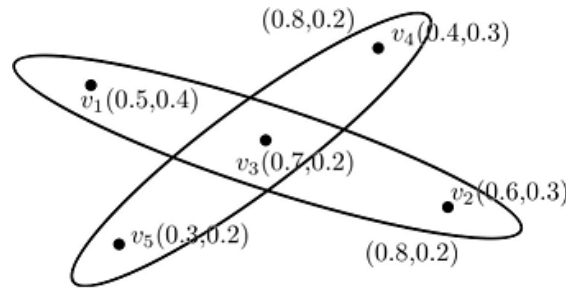
Figure 2. **Uniform IFSHG**

3. Conclusion

Hypergraphs are considered as the most efficient representation to handle the complicated practical problems in real life. An IFSS is an extension of fuzzy soft set, used to deal with uncertain information under complexity based on the parameters. So, by combining both IFSS and hypergraphs a notion of IFSHGs are given and also discussed about regular - IFSHGs and totally regular IFSHGs. Moreover the author intend to extent the research work in Edge-Regular and Edge-Irregular IFSHGs.

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Recognizing emotions using elementary hyperedges in intuitionistic fuzzy soft hypergraphs *

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Abstract   In this paper, we introduce the notion of intuitionistic fuzzy soft hypergraphs(IFSHGs), certain types of IFSHGs including core, simple, elementary, sectionally elementary, (μ, ν)-tempered (IFSHGs) are dealt with examples. Also this concept is analyzed in emotion recognition as an application too.

Key words   Intuitionistic fuzzy soft hypergraphs(IFSHGs), Core, Simple, Support Simple, Elementary and Sectionally elementary IFSHGs, (μ, ν)-tempered IFSHG.

2020 Mathematics Subject Classification   03F55, 05C65, 05C72, 68R10.

1 Introduction

The concept of fuzzy set theory was first initiated by Zadeh [19] to deal with uncertainty and vagueness. Since then the theory of fuzzy sets is used by many researchers [1,2] to solve real life problems involving uncertainty. In 1986, Atanassov [3,4] introduced the concept of intuitionistic fuzzy sets as a generalization of fuzzy sets. He added a new component which determines the degree of non-membership in the definition of fuzzy set. The fuzzy sets give the degree of membership of an element in a given set, while intuitionistic fuzzy sets give both a degree of membership and a degree of non-membership which are more or less independent from each other. In 1999, Molodtsov [11] initiated soft set theory as a general mathematical tool for dealing with uncertainty from the viewpoint of parameterization. Maji et al. [8,9] et al. studied soft set theory and introduced a new concept of fuzzy soft set by combining fuzzy set and soft set. Also by using the concept of soft set with intuitionistic fuzzy sets and he gave the noble concept of intuitionistic fuzzy soft set. The idea of graph theory was introduced by Euler. In order to expand the application base, the idea of graphs is generalized to a hypergraph, that is, a set V of vertices together with a collection of subsets of V. In 1975, Rosenfeld [16] introduced the concept of fuzzy graphs. In 1976, Berge [5] introduced the concept of fuzzy hypergraphs. Later in 2000, Moderson and Nair [12] et al. initiated the concept of fuzzy graphs and fuzzy hypergraphs. Karunambigai and Parvathi [6] discussed the concepts of intuitionistic fuzzy graphs. Further the concepts like degree, order and size in intuitionistic fuzzy graphs were proposed by Nagoorgani [14]. In 2009, Parvathi et

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al. [15] introduced and studied the concept of intuitionistic fuzzy hypergraphs with its application. Mythili et al. [13] defined certain types of intuitionistic fuzzy directed hypergraphs. In 2014, Thumbakara and George [18] discussed the concept of soft graphs in the specific way. The concept of fuzzy soft graphs introduced by Mohinta and Samanta [10] in 2015. Recently, intuitionistic fuzzy soft graphs were developed by many authors [7, 17] due to their application in Operations Research, Probability, Optimization, Complex Networks, Recognition of Objects, Images, etc. This paved a way to develop a new notion of IFSHGs. In this paper, section 2 deals with the basic definitions where we introduce the notion of intuitionistic fuzzy soft hypergraphs (IFSHGs) and the definitions of the order, size, degree and the strength of an IFSHG. In section 3, we introduce certain types of IFSHGs including core, simple, elementary, sectionally elementary, (μ, ν)-tempered (IFSHGs) are dealt with examples. An application for IFSHGs is identified in emotion recognition and is presented in section 4. Finally the conclusion is given in section 5.

2 Preliminaries

This section deals with the basic definitions like the fuzzy set, the soft set, the fuzzy soft set, the fuzzy soft graph, the intuitionistic fuzzy soft set and the intuitionistic fuzzy soft graph.

Notations List:

- Let U be the universe set and R be the set of all parameters.
- $\tilde{H} = (\mathfrak{N}, \mathfrak{S})$ is an intuitionistic fuzzy soft hypergraph (IFSHG).
- Order and size denoted by $\mathcal{O}(\tilde{H})$, $\mathcal{S}(\tilde{H})$ respectively.
- $\langle \mathfrak{N}_\mu, \mathfrak{N}_\nu \rangle$ or simply $\langle \mu_i, \nu_i \rangle$ denotes the degrees of membership and nonmembership of the vertex $v_i \in V$, such that $0 \leq \mathfrak{N}_\mu + \mathfrak{N}_\nu \leq 1$.
- $\langle \mathfrak{S}_\mu, \mathfrak{S}_\nu \rangle$ or simply $\langle \mu_{ij}, \nu_{ij} \rangle$ denotes the degrees of membership and nonmembership of the hyperedge $v_i, v_j \in V \times V$, such that $0 \leq \mathfrak{S}_\mu + \mathfrak{S}_\nu \leq 1$.
- $P(V \times V)$ is an intuitionistic fuzzy power set.
- $P(V)$ and $P(E)$ denote the sets of all intuitionistic fuzzy soft sets over V and E respectively.
- The support of an intuitionistic fuzzy soft set V in $\mathfrak{S}$ is denoted by supp $\mathfrak{E}_j(a_i) = \{v_i / \mathfrak{S}_\mu(a_i) > 0$ and $\mathfrak{S}_\nu(a_i) > 0, a_i \in R\}$.

Definition 2.1. [19] A *fuzzy set* $\mathcal{F}$ on a set V is characterized by its membership function $\mu_\mathcal{F} : V \to [0, 1]$, where $\mu_\mathcal{F}(u)$ is the degree of membership of an element u in a fuzzy set $\mathcal{F}$ for $u \in V$.

Definition 2.2. [9, 11] Let $P(U)$ denotes the power set of U. An ordered pair (F, R) is said to be a *soft set* over U, where $F : R \to P(U)$.

Definition 2.3. [8] If $M \subseteq R$ and $\mathcal{F}^U$ be the collection of all fuzzy subsets of U. Then $(\tilde{F}, M)$ is called *fuzzy soft set*, where $\tilde{F} : M \to \mathcal{F}^U$ is a mapping called fuzzy approximate function of the fuzzy soft set $(\tilde{F}, M)$.

Definition 2.4. [8] If $M \subseteq R$ and $\mathcal{IF}^U$ denotes the set of all intuitionistic fuzzy sets of U. A pair (F, M) is called an *intuitionistic fuzzy soft set* over U, where intuitionistic fuzzy approximation function is given by $F = (F_\mu, F_\nu) : M \to \mathcal{IF}^U$.

Definition 2.5. [10] A fuzzy soft graph $\tilde{G} = (\tilde{F}, \tilde{K}, R)$ is a 3-tuple, such that

- $(\tilde{F}, R)$ is a fuzzy soft set over V.
- $(\tilde{K}, R)$ is a fuzzy soft set over E.
- $(\tilde{F}(a), \tilde{K}(a))$ is a fuzzy subgraph of $\tilde{G}$ for all $a \in R$.

That is, $\tilde{K}(a)(xy) \leq \min\left\{ \tilde{F}(a)(x), \tilde{F}(a)(y) \right\}$ for all $a \in R$ and $x, y \in V$.

Definition 2.6. [7, 17] An intuitionistic fuzzy soft graph (IFSG) on a nonempty set V is an ordered 3-tuple $G = (F, K, R)$ such that

- (F, R) is an intuitionistic fuzzy soft set over V.
- (K, R) is an intuitionistic fuzzy relation on V. That is, $K : R \to P(V \times V)$.
- $(F(a), K(a))$ is an intuitionistic fuzzy soft subgraph for all $a \in R$.

That is,

1. $K_\mu(a)(uv) \leq \min\{F_\mu(a)(u), K_\mu(a)(v)\}$
2. $K_\nu(a)(uv) \leq \max\{F_\nu(a)(u), K_\nu(a)(v)\}$,

such that $0 \leq K_\mu(a)(uv) + K_\nu(a)(uv) \leq 1$, for every $a \in R$ and $u, v \in V$.

Definition 2.7. An intuitionistic fuzzy soft hypergraph (IFSHG) $\tilde{H} = (H^*, \mathfrak{N}, \mathfrak{S}, R)$ is an ordered 4-tuple, such that
- $H^* = \langle V, E \rangle$ is a intutionistic fuzzy hypergraph.
- $(\mathfrak{N}, R)$ is an intuitionistic fuzzy soft set over V.
- $(\mathfrak{S}, R)$ is an intuitionistic fuzzy relation on V. That is $\mathfrak{S} : R \to P(V \times V)$.
- $(\mathfrak{N}(a), \mathfrak{S}(a))$ is an intuitionistic fuzzy soft subhypergraph for all $a \in R$.

That is,

1. $\mathfrak{S}_\mu(a)(x_1, ..., x_n) \leq \max\{\mathfrak{N}_\mu(a)(x_1), \mathfrak{N}_\mu(a)(x_2), ..., \mathfrak{N}_\mu(a)(x_n)\}$,
2. $\mathfrak{S}_\nu(a)(x_1, ..., x_n) \leq \min\{\mathfrak{N}_\nu(a)(x_1), \mathfrak{N}_\nu(a)(x_2), ..., \mathfrak{N}_\nu(a)(x_n)\}$,

such that $0 < \mathfrak{S}_\mu(a)(x_1, ..., x_n) + \mathfrak{N}_\nu(a)(x_1, ..., x_n) \leq 1$, for all $a \in R$ and $x_1, ..., x_n \in V$, where, $\mathfrak{S}_\mu(a)(x_1, ..., x_n)$ denotes the degree of membership and $\mathfrak{S}_\nu(a)(x_1, ..., x_n)$ denotes the degree of non-membership of vertex to intuitionistic fuzzy soft hyperedge $\mathfrak{S}_j$.
An intuitionistic fuzzy soft hypergraph is denoted by $\tilde{H} = (\mathfrak{N}(a), \mathfrak{S}(a))$.

Example 2.8. Consider an IFSHG $\tilde{H} = (\mathfrak{N}, \mathfrak{S})$ such that $\mathfrak{N} = \{v_1, v_2, v_3, v_4, v_5\}$ and $\mathfrak{S} = \{v_1v_2v_3, v_2v_3 v_4, v_3v_4v_5, v_1v_2, v_4v_5\}$. Let $R = \{a_1, a_2, a_3\}$ be a parameter set. Let $(\mathfrak{N}, R)$ be an intuitionistic fuzzy soft set over V with its approximate function $\mathfrak{N} : R \to P(V)$ defined by
$\mathfrak{N}(a_1) = \{v_1\langle 0.3, 0.4\rangle, v_2\langle 0.5, 0.2\rangle, v_3\langle 0.7, 0.3\rangle, v_4\langle 0.2, 0.8\rangle, v_5\langle 0.6, 0.4\rangle\}$
$\mathfrak{N}(a_2) = \{v_1\langle 0.5, 0.2\rangle, v_2\langle 0.4, 0.1\rangle, v_3\langle 0.3, 0.7\rangle, v_4\langle 0.8, 0.1\rangle\}$
$\mathfrak{N}(a_3) = \{v_1\langle 0.4, 0.4\rangle, v_2\langle 0.6, 0.2\rangle, v_3\langle 0.3, 0.7\rangle\}$
Let $(\mathfrak{S}, R)$ be an intuitionistic fuzzy soft set over E with its approximate function $\mathfrak{S} : R \to P(E)$ defined by
$\mathfrak{S}(a_1) = \{v_1v_2v_3\langle 0.7, 0.2\rangle, v_1v_2\langle 0.5, 0.2\rangle, v_3v_4v_5\langle 0.7, 0.3\rangle, v_2v_3v_4\langle 0.7, 0.2\rangle, v_4v_5\langle 0.6, 0.4\rangle\}$
$\mathfrak{S}(a_2) = \{v_1v_2v_3\langle 0.5, 0.1\rangle, v_1v_2\langle 0.5, 0.1\rangle, v_2v_3v_4\langle 0.8, 0.1\rangle\}$
$\mathfrak{S}(a_3) = \{v_1v_2v_3\langle 0.6, 0.2\rangle, v_1v_2\langle 0.6, 0.2\rangle\}$
Thus $\tilde{H}(a_1) = (\mathfrak{N}(a_1), \mathfrak{S}(a_1))$, $\tilde{H}(a_2) = (\mathfrak{N}(a_2), \mathfrak{S}(a_2))$, $\tilde{H}(a_3) = (\mathfrak{N}(a_3), \mathfrak{S}(a_3))$ are IFSHGs corresponding to the parameters a_1, a_2, a_3 respectively.

Table 1: The tabular representation of $\mathfrak{N}$ for IFSHGs.

$\mathfrak{N}$	v_1	v_2	v_3	v_4	v_5
a_1	$\langle 0.3, 0.4\rangle$	$\langle 0.5, 0.2\rangle$	$\langle 0.7, 0.3\rangle$	$\langle 0.2, 0.8\rangle$	$\langle 0.6, 0.4\rangle$
a_2	$\langle 0.5, 0.2\rangle$	$\langle 0.4, 0.1\rangle$	$\langle 0.3, 0.7\rangle$	$\langle 0.8, 0.1\rangle$	$\langle 0.0, 1.0\rangle$
a_3	$\langle 0.4, 0.4\rangle$	$\langle 0.6, 0.2\rangle$	$\langle 0.3, 0.7\rangle$	$\langle 0.0, 1.0\rangle$	$\langle 0.0, 1.0\rangle$

Hence, $\tilde{H} = (H^*, \mathfrak{N}, \mathfrak{S}, R)$ is an IFSHG (see Fig. 1, Table 1 and Table 2).

Definition 2.9. The order of an IFSHG is

$$\mathcal{O}(\tilde{H}) = \left\langle \sum_{a_i \in R} \left(\sum_{v \in V} \mathfrak{N}_\mu(v) \right), \sum_{a_i \in R} \left(\sum_{v \in V} \mathfrak{N}_\nu(v) \right) \right\rangle.$$
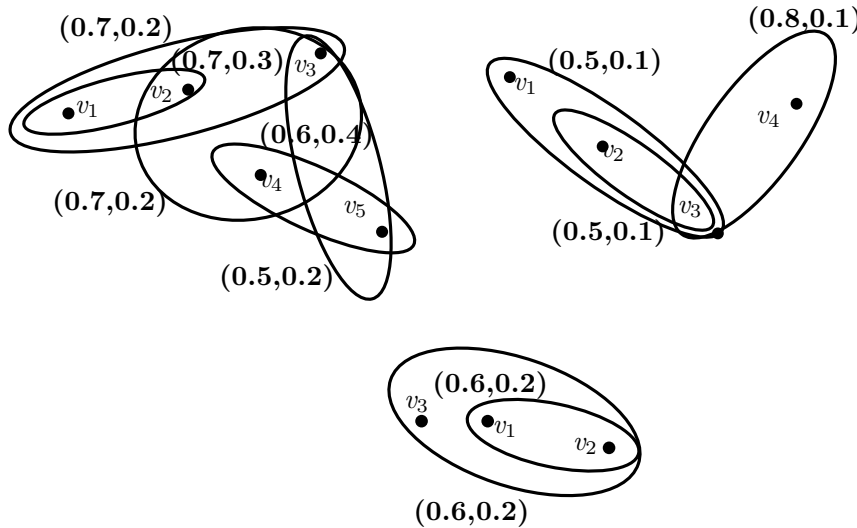
Fig. 1: Intuitionistic fuzzy soft hypergraphs.

Table 2: The tabular representation of $\mathfrak{S}$ for IFSHGs.

$\mathfrak{S}$	$v_1 v_2 v_3$	$v_1 v_2$	$v_3 v_4 v_5$	$v_2 v_3 v_4$	$v_4 v_5$
a_1	$\langle 0.7, 0.2 \rangle$	$\langle 0.5, 0.2 \rangle$	$\langle 0.7, 0.3 \rangle$	$\langle 0.7, 0.2 \rangle$	$\langle 0.6, 0.4 \rangle$
a_2	$\langle 0.5, 0.1 \rangle$	$\langle 0.5, 0.1 \rangle$	$\langle 0.0, 1.0 \rangle$	$\langle 0.8, 0.1 \rangle$	$\langle 0.0, 1.0 \rangle$
a_3	$\langle 0.6, 0.2 \rangle$	$\langle 0.6, 0.2 \rangle$	$\langle 0.0, 1.0 \rangle$	$\langle 0.0, 1.0 \rangle$	$\langle 0.0, 1.0 \rangle$

Definition 2.10. The size of an IFSHG is

$$\mathcal{S}(\tilde{H}) = \left\langle \sum_{a_i \in R} \left(\sum_{v_1,\ldots,v_n \in \mathfrak{S}} \mathfrak{S}_\mu(a_i)(v_1 \ldots v_n) \right), \sum_{a_i \in R} \left(\sum_{v_1,\ldots,v_n \in \mathfrak{S}} \mathfrak{S}_\nu(a_i)(v_1 \ldots v_n) \right) \right\rangle.$$

Definition 2.11. The degree of an IFSHG is

$$\deg(v) = \left\langle \deg\mathfrak{N}_\mu(a_i)(v_i), \deg\mathfrak{N}_\nu(a_i)(v_i) \right\rangle,$$

where $\deg\mathfrak{N}_\mu(a_i)(v_i)$ denotes the sum of membership values of the hyperedge that contains the vertex v_i corresponding to the parameter $a_i \in R$ and $\deg\mathfrak{N}_\nu(a_i)(v_i)$ denotes the sum of non-membership values of the hyperedge that contains the vertex v_i corresponding to the parameter $a_i \in R$.

Example 2.12. Consider an IFSHG $\tilde{H} = (\mathfrak{N}, \mathfrak{S})$ such that $\mathfrak{N} = \{v_1, v_2, v_3, v_4\}$ and $\mathfrak{S} = \{v_1 v_3, v_1 v_4, v_2 v_3 v_4\}$. Let $R = \{a_1, a_2, a_3\}$ be a parameter set. Let $(\mathfrak{N}, R)$ be an intuitionistic fuzzy soft set over V with its approximate function $\mathfrak{N} : R \to P(V)$ defined by
$\mathfrak{N}(a_1) = \{v_1 \langle 0.3, 0.4 \rangle, v_2 \langle 0.8, 0.2 \rangle, v_3 \langle 0.7, 0.2 \rangle, v_4 \langle 0.5, 0.1 \rangle\}$
$\mathfrak{N}(a_2) = \{v_1 \langle 0.5, 0.2 \rangle, v_2 \langle 0.9, 0.1 \rangle, v_3 \langle 0.6, 0.4 \rangle, v_4 \langle 0.8, 0.2 \rangle\}$
$\mathfrak{N}(a_3) = \{v_1 \langle 0.4, 0.4 \rangle, v_2 \langle 0.8, 0.2 \rangle, v_3 \langle 0.7, 0.3 \rangle, v_4 \langle 0.3, 0.6 \rangle\}$
Let $(\mathfrak{S}, R)$ be an intuitionistic fuzzy soft set over E with its approximate function $\mathfrak{S} : R \to P(E)$ defined by
$\mathfrak{S}(a_1) = \{v_1 v_3 \langle 0.7, 0.2 \rangle, v_1 v_4 \langle 0.5, 0.1 \rangle, v_2 v_3 v_4 \langle 0.8, 0.1 \rangle\}$
$\mathfrak{S}(a_2) = \{v_1 v_3 \langle 0.6, 0.2 \rangle, v_1 v_4 \langle 0.8, 0.2 \rangle, v_2 v_3 v_4, \langle 0.9, 0.1 \rangle\}$

$\mathfrak{S}(a_3) = \{v_1v_3\langle 0.7, 0.3\rangle, v_1v_4\langle 0.4, 0.4\rangle, v_2v_3v_4\langle 0.8, 0.2\rangle\}$

$\mathcal{O}(\tilde{H}) = \left\langle \sum_{a_i \in R}\left(\sum_{v \in V}\mathfrak{N}_\mu(v)\right), \sum_{a_i \in R}\left(\sum_{v \in V}\mathfrak{N}_\nu(v)\right)\right\rangle.$

$= [(0.3 + 0.8 + 0.7 + 0.5) + (0.5 + 0.9 + 0.6 + 0.8) + (0.4 + 0.8 + 0.7 + 0.3),$

$(0.4 + 0.6 + 0.2 + 0.1) + (0.2 + 0.1 + 0.5 + 0.4) + (0.4 + 0.2 + 0.5 + 0.6)]$

$= [(2.3 + 2.8 + 2.2), (1.3 + 1.2 + 1.7)]$

$= \langle 7.3, 4.2\rangle$

$\mathcal{S}(\tilde{H}) = \left\langle \sum_{a_i \in R}\left(\sum_{v_1...v_n \in \mathfrak{S}}\mathfrak{S}_\mu(a_i)(v_1...v_n)\right), \sum_{a_i \in R}\left(\sum_{v_1...v_n \in \mathfrak{S}}\mathfrak{S}_\nu(a_i)(v_1...v_n)\right)\right\rangle.$

$= [(0.7 + 0.5 + 0.8) + (0.6 + 0.8 + 0.9) + (0.7 + 0.4 + 0.8),$

$(0.2 + 0.1 + 0.1) + (0.2 + 0.2 + 0.1) + (0.3 + 0.4 + 0.2)].$

$= [(2.0 + 2.3 + 1.9), (0.4, 0.5, 0.9)]$

$= \langle 6.2, 1.8\rangle.$
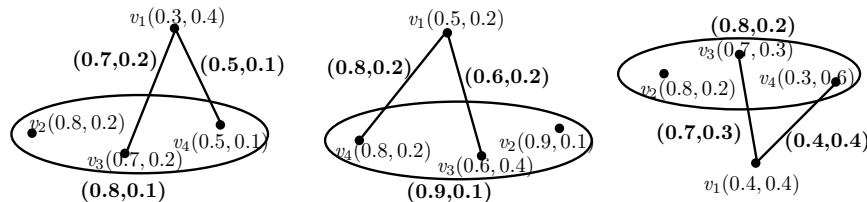
Fig. 2: IFSHGs for the parameters a_1, a_2, a_3.

The degree of the vertex v_i corresponding to the parameter a_1, $\deg(v_1) = \langle 1.2, 0.3\rangle$, $\deg(v_2) = \langle 0.8, 0.1\rangle$, $\deg(v_3) = \langle 1.5, 0.3\rangle$, $\deg(v_4) = \langle 1.3, 0.2\rangle$.

The degree of the vertex v_i corresponding to the parameter a_2, $\deg(v_1) = \langle 1.4, 0.4\rangle$, $\deg(v_2) = \langle 0.9, 0.1\rangle$, $\deg(v_3) = \langle 1.5, 0.3\rangle$, $\deg(v_4) = \langle 1.7, 0.3\rangle$.

The degree of the vertex v_i corresponding to the parameter a_3, $\deg(v_1) = \langle 1.1, 0.7\rangle$, $\deg(v_2) = \langle 0.8, 0.2\rangle$, $\deg(v_3) = \langle 1.5, 0.5\rangle$, $\deg(v_4) = \langle 1.2, 0.6\rangle$.

The degree of the vertex v_i differs in their values with respect to the parameters.

Definition 2.13. The strength (η) of a hyperedge $\mathfrak{S}_j$ of an IFSHG is the maximum of a membership value and minimum of a non-membership value.

$\eta\big(\mathfrak{S}_j(a_i)\big) = \big(\max_{v \in V}(\mathfrak{N}_\mu(v_i))(a_i), \min_{v \in V}(\mathfrak{N}_\nu(v_i))(a_i)\big)$, such that $\mathfrak{N}_\mu(v_i) > 0$ and $\mathfrak{N}_\nu(v_i) > 0$.

Example 2.14. In Fig. 2 the strength (η) of a hyperedge $\mathfrak{S}_j$ with respect to the corresponding parameters are as follows,

$\eta(\mathfrak{S}_1)(a_1) = \langle 0.7, 0.2\rangle, \eta(\mathfrak{S}_2)(a_1) = \langle 0.5, 0.1\rangle, \eta(\mathfrak{S}_3)(a_1) = \langle 0.8, 0.1\rangle$

$\eta(\mathfrak{S}_1)(a_2) = \langle 0.6, 0.2\rangle, \eta(\mathfrak{S}_2)(a_2) = \langle 0.8, 0.2\rangle, \eta(\mathfrak{S}_3)(a_2) = \langle 0.8, 0.1\rangle$

$\eta(\mathfrak{S}_1)(a_3) = \langle 0.7, 0.3\rangle, \eta(\mathfrak{S}_2)(a_3) = \langle 0.4, 0.4\rangle, \eta(\mathfrak{S}_3)(a_3) = \langle 0.8, 0.2\rangle$

The incidence matrix corresponding to the strength of a hyperedge is given below:

$$\begin{array}{c|ccc} \eta & \mathfrak{S}_1 & \mathfrak{S}_2 & \mathfrak{S}_3 \\ a_1 & \langle 0.7, 0.2\rangle & \langle 0.5, 0.1\rangle & \langle 0.8, 0.1\rangle \\ a_2 & \langle 0.6, 0.2\rangle & \langle 0.8, 0.2\rangle & \langle 0.8, 0.1\rangle \\ a_3 & \langle 0.7, 0.3\rangle & \langle 0.4, 0.4\rangle & \langle 0.8, 0.2\rangle \end{array}$$

Note: Among the strength of a hyperedges, the hyperedge which possess minimum of membership value and maximum of non-membership value in the corresponding parameters is said to be *stronger*. Thus the hyperedges $\mathfrak{S}_2$ in the parameter a_3 is stronger than the other hypergedges in a_1 and a_2.

3   Certain types of intuitionistic fuzzy soft hypergraphs

Definition 3.1. Let $\tilde{H}$ be an IFSHG. The height of $\tilde{H}$, is defined by

$$\mathbf{h}(\tilde{H}(a)) = \{(\max\mathfrak{E}_j, \min\mathfrak{E}_k) \, | \mathfrak{E}_j, \mathfrak{E}_k \in \mathfrak{S}\}.$$

where $\mathfrak{E}_j = \max\mathfrak{E}_\mu(a)(v_1...v_n)$ and $\mathfrak{E}_k = \min\mathfrak{E}_\nu(a)(v_1...v_n)$, $a \in R$, for all $j = 1, 2, ..., n$ and $k = 1, 2, ..., m$.

Definition 3.2. An IFSHG $\tilde{H} = (\mathfrak{N}, \mathfrak{S})$ is *simple* if hyperedge $\mathfrak{S}$ has no repeated intuitionistic fuzzy hyperedges, whenever $\mathfrak{E}_j, \mathfrak{E}_k \in \mathfrak{S}$ and $\mathfrak{E}_j(a_i) \subseteq \mathfrak{E}_k(a_i)$ then $\mathfrak{E}_j(a_i) = \mathfrak{E}_k(a_i)$ for all j and k, $a_i \in R$.
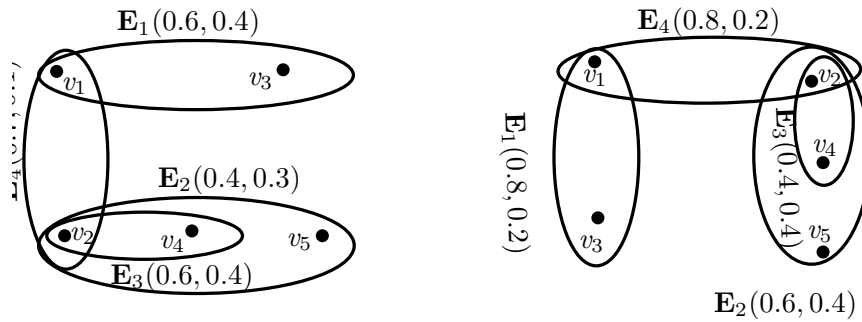
Example 3.3. Consider an IFSHG $\tilde{H} = (\mathfrak{N}, \mathfrak{S})$, such that $\mathfrak{N} = \{v_1, v_2, v_3, v_4, v_5\}$ and $\mathfrak{S} = \{E_1, E_2, E_3, E_4\}$. Let $R = \{a_1, a_2\}$ be a parameter set. Let $(\mathfrak{N}, R)$ be an intuitionistic fuzzy soft set over V with its approximate function $\mathfrak{N} : R \to P(V)$.
$\mathfrak{N}(a_1) = \{v_1\langle 0.7, 0.3\rangle, v_2\langle 0.5, 0.4\rangle, v_3\langle 0.8, 0.3\rangle, v_4\langle 0.6, 0.2\rangle, v_5\langle 0.3, 0.3\rangle\}$
$\mathfrak{N}(a_2) = \{v_1\langle 0.5, 0.4\rangle, v_2\langle 0.4, 0.4\rangle, v_3\langle 0.6, 0.3\rangle, v_4\langle 0.6, 0.4\rangle, v_5\langle 0.5, 0.1\rangle\}$.
Let $(\mathfrak{S}, R)$ be an intuitionistic fuzzy soft set over E with its approximate function $\mathfrak{S} : R \to P(E)$.
$\mathfrak{S}(a_1) = \{E_1\langle 0.7, 0.3\rangle, E_2\langle 0.8, 0.2\rangle, E_3\langle 0.5, 0.3\rangle, E_4\langle 0.7, 0.2\rangle\}$
$\mathfrak{S}(a_2) = \{E_1\langle 0.5, 0.4\rangle, E_2\langle 0.6, 0.3\rangle, E_3\langle 0.5, 0.1\rangle, E_4\langle 0.6, 0.4\rangle\}$
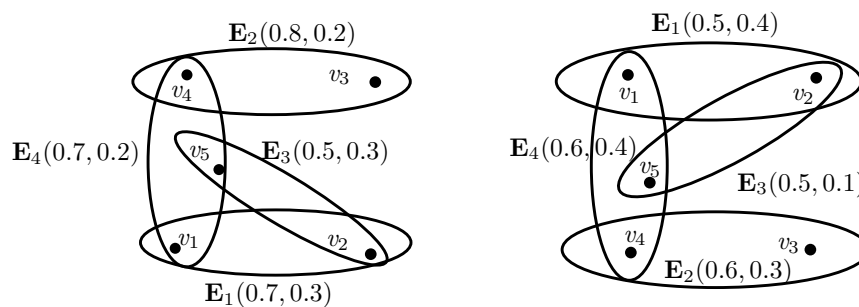
Fig. 3: Simple.

The incidence matrix corresponding to the parameters of a hyperedge is given below (Fig. 3):

$$\begin{array}{c c c c c} \mathfrak{S} & E_1 & E_2 & E_3 & E_4 \\ a_1 & \langle 0.7, 0.3\rangle & \langle 0.8, 0.2\rangle & \langle 0.5, 0.3\rangle & \langle 0.7, 0.2\rangle \\ a_2 & \langle 0.5, 0.4\rangle & \langle 0.6, 0.3\rangle & \langle 0.5, 0.1\rangle & \langle 0.6, 0.4\rangle \end{array}$$

Definition 3.4. An IFSHG $\tilde{H} = (\mathfrak{N}, \mathfrak{S})$ is *support simple*, whenever $\mathfrak{E}_j, \mathfrak{E}_k \in \mathfrak{S}$ and $\mathfrak{E}_j(a_i) \subseteq \mathfrak{E}_k(a_i)$ and $\mathrm{supp}\mathfrak{E}_j(a_i) = \mathrm{supp}\mathfrak{E}_k(a_i)$, then $\mathfrak{E}_j(a_i) = \mathfrak{E}_k(a_i)$ for all j and k, $a_i \in R$. Hence the hyperedges are supporting hyperedges.

Example 3.5. Consider an IFSHG $\tilde{H} = (\mathfrak{N}, \mathfrak{S})$, such that $\mathfrak{N} = \{v_1, v_2, v_3, v_4, v_5\}$ and $\mathfrak{S} = \{E_1, E_2, E_3, E_4\}$. Let $R = \{a_1, a_2\}$ be a parameter set. Let $(\mathfrak{N}, R)$ be an intuitionistic fuzzy soft set over V with its approximate function $\mathfrak{N} : R \to P(V)$.
$\mathfrak{N}(a_1) = \{v_1\langle 0.8, 0.1\rangle, v_2\langle 0.5, 0.2\rangle, v_3\langle 0.6, 0.4\rangle, v_4\langle 0.8, 0.1\rangle, v_5\langle 0.8, 0.1\rangle\}$
$\mathfrak{N}(a_2) = \{v_1\langle 0.5, 0.3\rangle, v_2\langle 0.6, 0.4\rangle, v_3\langle 0.4, 0.4\rangle, v_4\langle 0.6, 0.3\rangle, v_5\langle 0.5, 0.4\rangle\}$
Let $(\mathfrak{S}, R)$ be an intuitionistic fuzzy soft set over E with its approximate function $\mathfrak{S} : R \to P(E)$.
$\mathfrak{S}(a_1) = \{E_1\langle 0.8, 0.1\rangle, E_2\langle 0.8, 0.1\rangle, E_3\langle 0.8, 0.1\rangle, E_4\langle 0.8, 0.1\rangle\}$
$\mathfrak{S}(a_2) = \{E_1\langle 0.6, 0.3\rangle, E_2\langle 0.6, 0.3\rangle, E_3\langle 0.6, 0.3\rangle, E_4\langle 0.6, 0.3\rangle\}$
The incidence matrix corresponding to the parameters of a hyperedge is given below (Fig. 4):

$$\begin{array}{c c c c c} \mathfrak{S} & E_1 & E_2 & E_3 & E_4 \\ a_1 & \langle 0.8, 0.1\rangle & \langle 0.8, 0.1\rangle & \langle 0.8, 0.1\rangle & \langle 0.8, 0.1\rangle \\ a_2 & \langle 0.6, 0.3\rangle & \langle 0.6, 0.3\rangle & \langle 0.6, 0.3\rangle & \langle 0.6, 0.3\rangle \end{array}$$
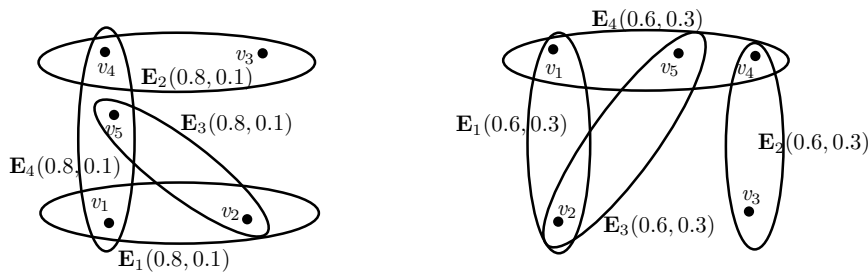
Fig. 4: Support simple.

Note: If the values of the hyperedges are same in the parameter then it is said to be uniform edge IFSHG.

Definition 3.6. Let $\tilde{H} = (\mathfrak{N}, \mathfrak{S})$ be an IFSHGs. Suppose $\mathfrak{E}_j, \mathfrak{E}_k \in \mathfrak{S}$ and $0 < (\alpha, \beta) < 1$. The (α, β) - level of the parameters $a_i \in R$ is defined by

$(\mathfrak{E}_j, \mathfrak{E}_k)^{\alpha, \beta}(a_i) = \left\{ v_i \in V / \max(\mu_{ij}^{\alpha}(v_i)(a_i) \geq \alpha), \min(\nu_{ij}^{\beta}(v_i)(a_i) \leq \beta) \right\}$.

Definition 3.7. Let $\tilde{H} = (\mathfrak{N}, \mathfrak{S})$ be an IFSHGs. For $0 < (s, r) < h(\tilde{H})$. Let $\tilde{H}_{s,r}$ be the $(s\text{-}r)$ level intuitionistic fuzzy hypergraph of H^*. The sequence of real numbers $(s_1, r_1), (s_2, r_2), ..., (s_n, r_n)$, such that $0 \leq s_i \leq h\mu(\tilde{H})$ and $0 \leq r_i \leq h_{\nu}(\tilde{H})$, where $(s_n, r_n) = h(\tilde{H})$, satisfying the properties,

- If $s_1 < \alpha \leq 1$ and $0 \leq r_1$, then $\mathfrak{S}^{\alpha, \beta} \neq \phi$ for all $a_i \in R$.
- If $s_{i+1} \leq \alpha \leq s_i$, $r_{i+1} \leq \beta \leq r_i$, then $\mathfrak{S}^{\alpha, \beta}(a_i) = \mathfrak{S}^{s_i, r_i}(a_i)$ for all $a_i \in R$.
- $\mathfrak{S}^{s_i, r_i}(a_i) \subset \mathfrak{S}^{s_{i+1}, r_{i+1}}(a_i)$ for all $a_i \in R$ is called the fundamental sequence of $\tilde{H}$ corresponding to the parameters and it is denoted by $F(\tilde{H})$.

The core set of $\tilde{H}$ is denoted by $\mathcal{C}(\tilde{H})$. It is defined by $\mathcal{C}(\tilde{H}) = \tilde{H}^{s_1, r_1}(a_i), \tilde{H}^{s_2, r_2}(a_i), ..., \tilde{H}^{s_n, r_n}(a_i)$. The corresponding set of (s_i, r_i)-level hypergraph $\tilde{H}^{s_1, r_1}(a_i) \subset \tilde{H}^{s_2, r_2}(a_i) \subset ... \subset \tilde{H}^{s_n, r_n}(a_i)$ is called the $\tilde{H}$ induced fundamental sequence and it is denoted by $\mathcal{I}(\tilde{H})$. The (s_n, r_n)-level is called the *support level* of $\tilde{H}$ and the $\tilde{H}^{s_n, r_n}(a_i)$ is called the *support* of $\tilde{H}$.

Definition 3.8. An IFSHG is said to be *elementary* if $\mu_{ij} : V \to [0, 1]$ and $\nu_{ij} : V \to [0, 1]$ are constant functions or has a range $\{0, e\}, e \neq 0$. If $|\text{supp}(\mu_{ij}, \nu_{ij})(a_i)| = 1$ then it is an intuitionistic fuzzy subsets with singleton support called a spike.

Example 3.9. Consider an IFSHG $\tilde{H} = (\mathfrak{N}, \mathfrak{S})$, such that $\mathfrak{N} = \{v_1, v_2, v_3, v_4, v_5\}$ and $\mathfrak{S} = \{E_1, E_2, E_3, E_4\}$. Let $R = \{a_1, a_2\}$ be a parameter set. Let $(\mathfrak{N}, R)$ be an intuitionistic fuzzy soft set over V with its approximate function $\mathfrak{N} : R \to P(V)$.
$\mathfrak{N}(a_1) = \{v_1\langle 0.6, 0.4\rangle, v_2\langle 0.2, 0.5\rangle, v_3\langle 0.6, 0.4\rangle, v_4\langle 0.4, 0.3\rangle, v_5\langle 0.7, 0.1\rangle\}$
$\mathfrak{N}(a_2) = \{v_1\langle 0.8, 0.2\rangle, v_2\langle 0.2, 0.5\rangle, v_3\langle 0.7, 0.3\rangle, v_4\langle 0.4, 0.4\rangle, v_5\langle 0.6, 0.4\rangle\}$
Let $(\mathfrak{S}, R)$ be an intuitionistic fuzzy soft set over E with its approximate function $\mathfrak{S} : R \to P(E)$.
$\mathfrak{S}(a_1) = \{E_1\langle 0.6, 0.4\rangle, E_2\langle 0.4, 0.3\rangle, E_3\langle 0.6, 0.4\rangle, E_4\langle 0.7, 0.1\rangle\}$
$\mathfrak{S}(a_2) = \{E_1\langle 0.8, 0.2\rangle, E_2\langle 0.6, 0.4\rangle, E_3\langle 0.4, 0.4\rangle, E_4\langle 0.8, 0.2\rangle\}$
The incidence matrix corresponding to the parameters of a hyperedge is given below (Fig. 5):

$$
\begin{array}{ccccc}
\mathfrak{S} & E_1 & E_2 & E_3 & E_4 \\
a_1 & \langle 0.6, 0.4\rangle & \langle 0.4, 0.3\rangle & \langle 0.6, 0.4\rangle & \langle 0.7, 0.1\rangle \\
a_2 & \langle 0.8, 0.2\rangle & \langle 0.6, 0.4\rangle & \langle 0.4, 0.4\rangle & \langle 0.8, 0.2\rangle
\end{array}
$$

Definition 3.10. If $\tilde{H} = (\mathfrak{N}, \mathfrak{S})$ be an IFSHG and $F(\tilde{H}) = s_n, s_{n-1}, ..., s_1, r_1, ..., r_n$. Then $\tilde{H}$ is called *sectionally elementary* if for each $\mu_{ij}, \nu_{ij} \in \mathfrak{S}$ and $s_i, r_i \in F(\tilde{H})$, $\mu_{ij}^{\alpha} = \mu_{ij}^{s_i}$ and $\nu_{ij}^{\beta} = \nu_{ij}^{r_i}$ for all $\alpha, \beta \in (s_{i+1}, r_i]$. Assume $s_{i+1} = 0$.

Fig. 5: Elementary IFSHGs.

Example 3.11. Consider an IFSHG $\tilde{H} = (\mathfrak{N}, \mathfrak{S})$, such that $\mathfrak{N} = \{v_1, v_2, v_3, v_4, v_5\}$ and $\mathfrak{S} = \{E_1, E_2, E_3\}$. Let $R = \{a_1, a_2\}$ be a parameter set. Let $(\mathfrak{N}, R)$ be an intuitionistic fuzzy soft set over V with its approximate function $\mathfrak{N} : R \to P(V)$.

$\mathfrak{N}(a_1) = \{v_1\langle 0.6, 0.4\rangle, v_2\langle 0.5, 0.4\rangle, v_3\langle 0.5, 0.3\rangle, v_4\langle 0.5, 0.4\rangle, v_5\langle 0.5, 0.4\rangle\}$
$\mathfrak{N}(a_2) = \{v_1\langle 0.7, 0.2\rangle, v_2\langle 0.4, 0.3\rangle, v_3\langle 0.9, 0.1\rangle, v_4\langle 0.7, 0.2\rangle, v_5\langle 0.5, 0.4\rangle\}$
Let $(\mathfrak{S}, R)$ be an intuitionistic fuzzy soft set over E with its approximate function $\mathfrak{S} : R \to P(E)$.
$\mathfrak{S}(a_1) = \{E_1\langle 0.6, 0.3\rangle, E_2\langle 0.5, 0.4\rangle, E_3\langle 0.5, 0.3\rangle\}$
$\mathfrak{S}(a_2) = \{E_1\langle 0.7, 0.2\rangle, E_2\langle 0.7, 0.2\rangle, E_3\langle 0.7, 0.2\rangle\}$
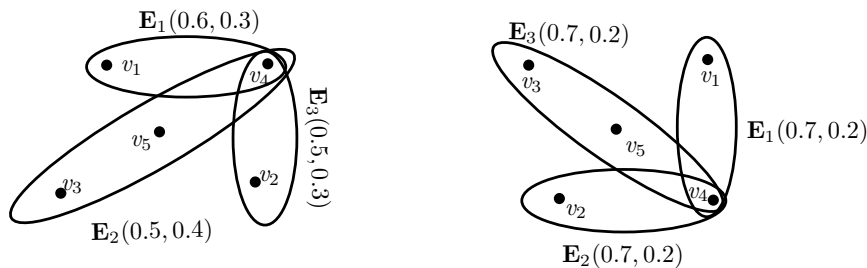
Fig. 6: Sectionally elementary IFSHGs.

The incidence matrix corresponding to the parameters of a hyperedge is given below (Fig. 6):

$$
\begin{array}{c c c c}
\mathfrak{S} & E_1 & E_2 & E_3 \\
a_1 & \left(\langle 0.6, 0.3\rangle\right. & \langle 0.5, 0.4\rangle & \langle 0.5, 0.3\rangle \\
a_2 & \langle 0.7, 0.2\rangle & \langle 0.7, 0.2\rangle & \left.\langle 0.7, 0.2\rangle\right)
\end{array}
$$

Definition 3.12. An IFSHG $\tilde{H} = (\mathfrak{N}, \mathfrak{S})$ is called (μ, ν)-tempered intuitionistic fuzzy soft hypergraph (TIFSHG) if there exists an intuitionistic fuzzy subsets $\mu_{ij} : V \to [0, 1]$ and $\nu_{ij} : V \to [0, 1]$ such that $\mathfrak{S} = \{(\mu_{ij}(a_i)(v_i), \nu_{ij}(a_i)(v_i))/v_i \in \mathfrak{S}_i\}$,
where

$$
\mu_{ij}(a_i)(v_i) = \begin{cases} \wedge\mu_j(y)(a_i)/y \in \mathfrak{S}, a_i \in R & \text{if } v_i \in \mathfrak{S}_i \\ 0, & \text{otherwise,} \end{cases}
$$

and

$$\nu_{ij}(a_i)(v_i) = \begin{cases} \vee \nu_j(y)(a_i)/y \in \mathfrak{S}, a_i \in R & \text{if } v_i \in \mathfrak{S}_i \\ 0, & \text{otherwise.} \end{cases}$$

Example 3.13. Consider an IFSHG $\tilde{H} = (\mathfrak{N}, \mathfrak{S})$, such that $\mathfrak{N} = \{v_1, v_2, v_3, v_4, v_5\}$ and $\mathfrak{S} = \{E_1, E_2, E_3, E_4\}$. Let $R = \{a_1, a_2\}$ be a parameter set. Let $(\mathfrak{N}, R)$ be an intuitionistic fuzzy soft set over V with its approximate function $\mathfrak{N} : R \to P(V)$. Let $(\mathfrak{S}, R)$ be an intuitionistic fuzzy soft set over E with its approximate function $\mathfrak{S} : R \to P(E)$. Define $\mu_{ij} : V \to [0, 1]$ and $\nu_{ij} : V \to [0, 1]$.
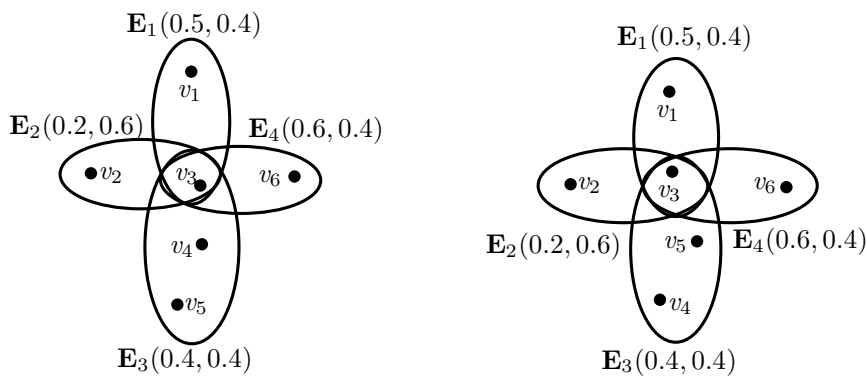
Fig. 7: (μ, ν)-tempered IFSHGs.

Considering for the parameter a_1,
$\mu_{1j}(v_1) = 0.5$, $\mu_{2j}(v_2) = 0.2$, $\mu_{3j}(v_3) = 0.6$, $\mu_{4j}(v_4) = 0.4$, $\mu_{5j}(v_5) = 0.4$, $\mu_{6j}(v_6) = 0.4$
$\nu_{1j}(v_1) = 0.4$, $\nu_{2j}(v_2) = 0.6$, $\nu_{3j}(v_3) = 0.4$, $\nu_{4j}(v_4) = 0.4$, $\nu_{5j}(v_5) = 0.4$, $\nu_{6j}(v_6) = 0.4$.
Note that
$\mu_{ij}(v_1) = \mu_1 j(v_1) \wedge \mu_3 j(v_3) = 0.5$
$\mu_{ij}(v_2) = \mu_1 j(v_2) \wedge \mu_3 j(v_3) = 0.2$
$\mu_{ij}(v_3) = \mu_1 j(v_3) \wedge \mu_3 j(v_1) = 0.4$
$\mu_{ij}(v_4) = \mu_1 j(v_3) \wedge \mu_3 j(v_4) = 0.4$
$\mu_{ij}(v_5) = \mu_1 j(v_4) \wedge \mu_3 j(v_5) = 0.4$
$\mu_{ij}(v_6) = \mu_1 j(v_3) \wedge \mu_3 j(v_6) = 0.6$
and
$\nu_{ij}(v_1) = \nu_1 j(v_1) \vee \nu_3 j(v_3) = 0.4$
$\nu_{ij}(v_2) = \nu_1 j(v_2) \vee \nu_3 j(v_3) = 0.6$
$\nu_{ij}(v_3) = \nu_1 j(v_3) \vee \nu_3 j(v_1) = 0.4$
$\nu_{ij}(v_4) = \nu_1 j(v_3) \vee \nu_3 j(v_4) = 0.4$
$\nu_{ij}(v_5) = \nu_1 j(v_4) \vee \nu_3 j(v_5) = 0.4$
$\nu_{ij}(v_6) = \nu_1 j(v_3) \vee \nu_3 j(v_6) = 0.4$

Table 3: The tabular representation of $\mathfrak{N}$ for (μ, ν)-tempered IFSHG.

$\mathfrak{N}$	v_1	v_2	v_3	v_4	v_5	v_6
a_1	$\langle 0.5, 0.3 \rangle$	$\langle 0.2, 0.6 \rangle$	$\langle 0.4, 0.1 \rangle$	$\langle 0.6, 0.4 \rangle$	$\langle 0.4, 0.2 \rangle$	$\langle 0.8, 0.2 \rangle$
a_2	$\langle 0.5, 0.4 \rangle$	$\langle 0.2, 0.6 \rangle$	$\langle 0.7, 0.3 \rangle$	$\langle 0.4, 0.4 \rangle$	$\langle 0.4, 0.4 \rangle$	$\langle 0.6, 0.4 \rangle$

Hence $\tilde{H}(a)$ is a (μ, ν)-tempered IFSHG (Fig. 7, Table 3 and Table 4).

Table 4: The tabular representation of $\mathfrak{S}$ for (μ, ν)-tempered IFSHG.

$\mathfrak{S}$	E_1	E_2	E_3	E_4
a_1	$\langle 0.5, 0.4 \rangle$	$\langle 0.2, 0.6 \rangle$	$\langle 0.4, 0.4 \rangle$	$\langle 0.6, 0.4 \rangle$
a_2	$\langle 0.5, 0.4 \rangle$	$\langle 0.2, 0.6 \rangle$	$\langle 0.4, 0.4 \rangle$	$\langle 0.6, 0.4 \rangle$

Theorem 3.14. *An IFSHG $\tilde{H} = (\mathfrak{N}, \mathfrak{S})$ is (μ, ν)-TIFSHG of some crisp hypergraph H if and only if $\tilde{H}$ is elementary, support simple and simply ordered.*

Proof. $\tilde{H} = (\mathfrak{N}, \mathfrak{S})$ be a (μ, ν)-TIFSHG, then in (μ, ν)-TIFSHG the membership values and non-membership values of an intuitionistic fuzzy soft hyperedges of $\tilde{H}$ are constant. Hence $\tilde{H}$ is elementary. It is obvious that the two intuitionistic fuzzy soft hyperedges of the (μ, ν)-TIFSHG are equal then the intuitionistic fuzzy soft hyperedges are equal. Hence it is support simple.
Let $\mathcal{C}(\tilde{H}) = \tilde{H}^{s_1,r_1}(a_i), \tilde{H}^{s_2,r_2}(a_i), ..., \tilde{H}^{s_n,r_n}(a_i)$ and since $\tilde{H}$ is elementary. $\tilde{H}$ is ordered. Let $a_i \in R$.
Claim(i): $\tilde{H}$ is simply ordered. Let $\mathfrak{S} \in H^{s_{i+1},r_{i+1}}(a_i) - H^{s_i,r_i}(a_i)$ then there exists $x_i \in \mathfrak{S}$ such that $\mu_{ij}(x_i)(a_i) = r_{i+1}$ and $\nu_{ij}(x_i)(a_i) = s_{i+1}$. Since $s_{i+1} < s_i$ and $r_{i+1} < r_i$, it follows that $(x_i)(a_i) \notin H^{s_i,r_i}(a_i)$ and $\mathfrak{E} \nsubseteq H^{s_i,r_i}(a_i)$.
Hence it is simply ordered.
Conversely, let $\tilde{H} = (\mathfrak{N}, \mathfrak{S})$ is elementary, support simple and simply ordered. By the core set definition $\tilde{H}^{s_i,r_i}(a_i) = \tilde{H}(\phi_i) = (\mathfrak{N}_i, \mathfrak{S}_i)$. Now we define $\mu_{ij} : \mathfrak{N}_i \to [0, 1]$ and $\nu_{ij} : \mathfrak{N}_i \to [0, 1]$ by

$$\mu_{ij}(x_i)(a_i) = \begin{cases} s_1 & \text{if } (x_i) \in \mathfrak{E}_1 \\ s_i & \text{if } (x_i) \in \mathfrak{E}_i \backslash \mathfrak{E}_{i-1}, i = 1, 2, ..., n \end{cases}$$

and

$$\nu_{ij}(x_i)(a_i) = \begin{cases} r_1 & \text{if } (x_i) \in \mathfrak{E}_1 \\ r_i & \text{if } (x_i) \in \mathfrak{E}_i \backslash \mathfrak{E}_{i-1}, i = 1, 2, ..., n \end{cases}$$

To prove: $\mathfrak{S} \{(\mu_{ij}(x_i)(a_i), \nu_{ij}(x_i)(a_i))\} | x_i \in \mathfrak{E}$, where

$$\mu_{ij}(x_i)(a_i) = \begin{cases} \wedge \mu_i(v)(a_i)/v \in \mathfrak{E} & \text{if } x_i \in \mathfrak{E} \text{ and } a_i \in R \\ 0 & \text{otherwise,} \end{cases}$$

and

$$\nu_{ij}(x_i)(a_i) = \begin{cases} \vee \nu_i(v)(a_i)/v \in \mathfrak{E} & \text{if } x_i \in \mathfrak{E} \text{ and } a_i \in R \\ 0 & \text{otherwise.} \end{cases}$$

Let $\mathfrak{E} \in \mathfrak{E}_i$. Since $\tilde{H}$ is elementary and support simple there is a unique intuitionistic fuzzy soft hyperedge $\mathfrak{E}_s$ in $\mathfrak{S}$ having support $\mathfrak{S}_i$.
To prove: $\mathfrak{E} \in \mathfrak{E}_i$. As all the intuitionistic fuzzy soft hyperedges are elementary and $\tilde{H}$ is support simple, then the different hyperedges have different supports, from the definition of fundamental sequence $h(\mathfrak{E}_s)$ is equal to some member of (s_i, r_i) of $F(\tilde{H})$. Consequently, $\mathfrak{E} \subseteq \mathfrak{N}_i$ and if $i > 1$, then $\mathfrak{E} \in \mathfrak{E}_i \backslash \mathfrak{E}_{i-1}$. From the definition of (μ, ν)-TIFSHG that for all $x_i \in \mathfrak{S}, \mu_{ij}(x_i)(a_i) \geq s_i$ and $\nu_{ij}(x_i)(a_i) \leq r_i$.
Claim(ii): $\mu_{ij}(x_i)(a_i) = s_i$ and $\nu_{ij}(x_i)(a_i) = r_i$ for some $x_i \in \mathfrak{S}$ and $a_i \in R$.
From the definition of (μ, ν)-TIFSHG, $\mu_{ij}(x_i)(a_i) \geq s_{i-1}$ and $\nu_{ij}(x_i)(a_i) \leq r_{i-1}$ for all $x_i \in \mathfrak{S}$ implies that $\mathfrak{S} \subseteq \mathfrak{N}_i$ and also $\mathfrak{E} \in \mathfrak{E}_i \backslash \mathfrak{E}_{i-1}$. Since H is simply ordered $\mathfrak{S} \nsubseteq \mathfrak{N}_i$, which is a contradiction. Thus from the definition of (μ, ν)-TIFSHG $\mathfrak{E} \in \mathfrak{E}_i$. Hence $\tilde{H}$ is (μ, ν)-TIFSHG. $\square$

Theorem 3.15. *An IFSHG $\tilde{H} = (\mathfrak{N}, \mathfrak{S})$ is simply ordered and the fundamental sequence is $\{s_n, s_{n-1}, ..., s_1, r_1, ..., r_n\}$ and if $\tilde{H}^{s_n,r_n}$ is a simple hypergraph then there is a partial IFSHG $\tilde{H}' = (\mathfrak{N}, \mathfrak{S}')$ of $\tilde{H}$ such that the following statements hold:*

(i) $\tilde{H}'$ is a (μ, ν)-TIFSHG of $\tilde{H}$.

(ii) $F(\tilde{H}') = F(\tilde{H})$ and $\mathcal{C}(\tilde{H}') = \mathcal{C}(\tilde{H})$.

Proof. Since $\tilde{H}$ is simply ordered, then $\tilde{H}$ is an IFSHG. For obtaining the partial IFSHG $\tilde{H}' = (\mathfrak{N}, \mathfrak{S}')$ of $\tilde{H} = (\mathfrak{N}, \mathfrak{S})$ remove the hyperedges of $\tilde{H}$ that are properly contained in another hyperedges of $\tilde{H}$, where $\mathfrak{S}' = \{\mu_{ij}(a_i), \nu_{ij}(a_i) \in \mathfrak{S}/ \text{ if } \mu_{ij}(a_i) \leq \nu_{ij}(a_i) \text{ then } \mu_{ij}(a_i) = \nu_{ij}(a_i)\}$. Since $\tilde{H}^{s_n, r_n}$ is simple and all intuitionistic soft hyperedges are elementary, one hyperedge cannot be contained in another hyperedge of $\tilde{H}$ since then both of them have the same support. Hence $F(\tilde{H}') = F(\tilde{H})$ and $\mathcal{C}(\tilde{H}') = \mathcal{C}(\tilde{H})$.

From the definition, $\tilde{H}'$ is support simple and satisfies all the conditions of Theorem 3.14. Thus $\tilde{H}'$ is a (μ, ν)-TIFSHG of $\tilde{H}$. $\qquad\square$

4   Application to emotion recognition

Emotion recognition is the task of classifying the emotion behind a piece of written text. The written text can be in the form of a sentence or sentences, a word or words, etc. and that written text identifies whether the user is happy or sad, or in fear or angered, or frustrated or disgusted and so on. Now we consider conversation between many users and their utterances (a piece of word or sentence) to recognize their emotions whether the users are happy or unhappy. We use hypergraph to represent between many users, by considering a set of utterances as vertices V. Here the vertices are utterances $v_1 = \text{keep going}, v_2 = \text{Are you okay}, v_3 = \text{getting down}, v_4 = \text{working together}, v_5 = \text{exercise daily respectively}$, where as the hyperedge represent the relationship between two utterances based on emotions with respect to their parameters. The parameter set (R) may be k-users of different situation handlers, here $R = \{a_1, a_2, a_3\}$ where, $a_1 = \text{players}, a_2 = \text{unhealthy persons}, a_3 = \text{business persons}$. Hence the membership and non-membership degree of a vertex denotes how much an utterance by user affects the emotions of the corresponding parameters. We consider an IFSHG $\tilde{H} = (\mathfrak{N}, \mathfrak{S}, R)$ where $(\mathfrak{N}, R)$ is an intuitionistic fuzzy soft set over V which describes the membership and non-membership values of the emotions based upon the given parameters. $(\mathfrak{S}, R)$ is an intuitionistic fuzzy soft set over $\mathfrak{S} \subseteq V \times V$ and it describes the membership and non-membership values of the relationship between two utterances corresponding to the given parameters a_1, a_2, a_3. For example, the utterance v_1 of a user holds 0.7 as a membership value) i.e., the utterance of a user makes 70% of happiness for the players. The hyperedge between the utterance v_1 and the utterance v_4 of a user can be 80% of happiness and 20% of unhappiness. An intuitionistic fuzzy soft hypergraph $\tilde{H} = \left\{\tilde{H}(a_1), \tilde{H}(a_2), \tilde{H}(a_3)\right\}$ corresponding to the parameter is given in Table 5 and Table 6.

Table 5: The tabular representation of $\mathfrak{N}$ for IFSHG.

$\mathfrak{N}$	v_1	v_2	v_3	v_4	v_5
a_1	$\langle 0.7, 0.1 \rangle$	$\langle 0.3, 0.7 \rangle$	$\langle 0.4, 0.5 \rangle$	$\langle 0.8, 0.2 \rangle$	$\langle 0.6, 0.4 \rangle$
a_2	$\langle 0.7, 0.3 \rangle$	$\langle 0.6, 0.4 \rangle$	$\langle 0.8, 0.2 \rangle$	$\langle 0.5, 0.5 \rangle$	$\langle 0.5, 0.3 \rangle$
a_3	$\langle 0.6, 0.2 \rangle$	$\langle 0.5, 0.4 \rangle$	$\langle 0.3, 0.4 \rangle$	$\langle 0.8, 0.1 \rangle$	$\langle 0.7, 0.3 \rangle$

Table 6: The tabular representation of $\mathfrak{S}$ for IFSHG.

$\mathfrak{S}$	E_1	E_2	E_3	E_4
a_1	$\langle 0.8, 0.1 \rangle$	$\langle 0.7, 0.1 \rangle$	$\langle 0.7, 0.1 \rangle$	$\langle 0.6, 0.4 \rangle$
a_2	$\langle 0.7, 0.3 \rangle$	$\langle 0.8, 0.2 \rangle$	$\langle 0.7, 0.3 \rangle$	$\langle 0.8, 0.2 \rangle$
a_3	$\langle 0.8, 0.1 \rangle$	$\langle 0.6, 0.2 \rangle$	$\langle 0.6, 0.2 \rangle$	$\langle 0.7, 0.3 \rangle$

The IFSHGs $\tilde{H}(a_1), \tilde{H}(a_2)$ and $\tilde{H}(a_3)$ corresponding to the parameters players, unhealthy persons, business persons respectively are shown in Fig. 8. By taking

$$\eta(\mathfrak{S}_j(a_i)) = \langle \max_{v \in V}(\mathfrak{N}_\mu(v_i))(a_i), \min_{v \in V}(\mathfrak{N}_\nu(v_i))(a_i), \rangle$$

such that $\mathfrak{N}_\mu(v_i) > 0$ and $\mathfrak{N}_\nu(v_i) > 0$, we obtain the strength of a hyperedge with respect to the

corresponding parameters players, unhealthy persons, business persons and is given by the following incidence matrix:

$$\begin{array}{c} \eta \\ a_1 \\ a_2 \\ a_3 \end{array} \begin{array}{cccc} E_1 & E_2 & E_3 & E_4 \\ \begin{pmatrix} \langle 0.8, 0.2 \rangle & \langle 0.7, 0.1 \rangle & \langle 0.7, 0.1 \rangle & \langle 0.6, 0.4 \rangle \\ \langle 0.7, 0.3 \rangle & \langle 0.8, 0.2 \rangle & \langle 0.7, 0.3 \rangle & \langle 0.8, 0.2 \rangle \\ \langle 0.8, 0.1 \rangle & \langle 0.6, 0.2 \rangle & \langle 0.6, 0.2 \rangle & \langle 0.7, 0.3 \rangle \end{pmatrix} \end{array}.$$

.
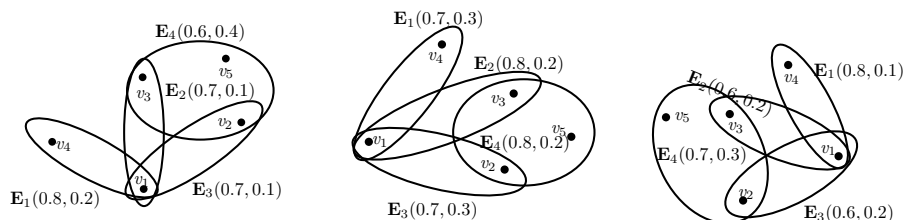
Fig. 8: IFSHGs for the parameters a_1, a_2, a_3.

The intuitionistic fuzzy hyperedges of an IFSHG corresponding to the parameters players, unhealthy persons, business persons respectively are elementary. Also, the hyperedge which possesses the minimum of membership value and the maximum of non-membership value in the corresponding parameters is said to be *stronger*. Thus the hyperedge E_4 in the parameter a_1 is stronger than the other hyperedges with respect to their parameters. The hyperedge E_4 has relationship between utterance v_2, utterance v_3 and utterance v_5, that the membership value and non-membership value of an utterances represent how much an utterance of a user is happy or unhappy based upon the parameter $a_1 = $ players. For the parameter a_1, the utterance v_2, the utterance v_3 and the utterance v_5 holds $\langle 0.3, 0.7 \rangle$, $\langle 0.4, 0.5 \rangle$ and $\langle 0.6, 0.4 \rangle$ as a membership value and a non-membership value respectively. That is, the utterance v_2 of a user may be 30% of happiness and 70% of unhappiness, the utterance v_3 of a user may be 40% of happiness and 50% of unhappiness and the utterance v_5 of a user may be 60% of happiness and 40% of unhappiness progressively. Since the hyperedge E_4 in the parameter a_1 is stronger and the hyperedge E_4 has relationship between the utterances v_2, v_3 and v_5 so that the user may be in the category of 60% of happiness and 40% of unhappiness for the parameter $a_1 = $ players. Thus based on the utterances and their relationship for the parameter players, the emotion recognized by the user is to be happy.

5 Conclusion

Soft set theory plays a significant role as a mathematical tool for mathematical modeling, system analysis and computing of decision making problems with uncertainty. An intuitionistic fuzzy soft model is a generalization of the fuzzy soft model which gives more precision, flexibility, and compatibility to a system when compared with the fuzzy soft model. We applied the concept of intuitionistic fuzzy soft sets to hypergraphs in this paper. We presented certain types of intuitionistic fuzzy soft hypergraphs and also proved that an IFSHG is elementary, support simple and simply ordered. An application of IFSHGs to emotion recognition is also discussed and we recognized emotion based on the strength of an hyperedge among the parameters. In future, we intend to extend our research of fuzzification to interval-valued intuitionistic fuzzy soft hypergraphs and bipolar intuitionistic fuzzy soft hypergraphs.

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THE SCONUL LENSES: A BIRD'S EYE VIEW

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Abstract

Inside the twenty first century, information capability is a response for the entire group, notwithstanding mature enough or experience. Understanding Information schooling is shown by the way wherein data and information are shaped and administered; ace capacities in administrating them, using and adjusting learning viewpoints, inclinations similarly as practices. SCONUL seven segment model of information instruction communicates that the information competent individual should acquire a stack of 7 capacities. These capacities are ordinary for any information capable person. However, when there is a necessity for changing and changing these capacities for moved arrangement of customers, the Lenses are considered. The SCONUL central focuses portray the information capability capacities required for unequivocal get-togethers of customers like researchers, graduates and nursing specialists. These central focuses withstand upon comparative seven sections focusing in on the specific social occasion of customers. The current paper enlightens four of the SCONUL central focuses to be explicit researcher point of convergence, high level training point of convergence, graduate employability point of convergence and OER point of convergence.

I. INTRODUCTION

Information capability could be a lot of cutoff points anticipating that individuals should "see when information is required and can discover, evaluate, and use effectively the necessary information" (American Library Association, 1989). Information Literacy means to empower people in differing foundations to search for, evaluate, use and make information enough to achieve their own, social, word related and enlightening targets (Horton, 2008, p.18). The scope of capability begins from Alphabetic instruction and tends towards Digital information training.

SCONUL: Seven Pillars of Information Literacy model depicts the middle limits and appreciation at the affectability of information capability improvement in high level training. This was gotten by overseers and researchers till 2011.To cook the necessities of different characterization of understudies assortments have been embedded without impacting the middle guidelines of SEVEN Pillars with changes needed for the legitimate regions. Few are :

(1) "Investigation point of convergence" which base on the examiners

(2) OER LENS (Open Content/Open Educational Resources point of convergence) (2013)

(3) Digital Lens

(4) Employability Lens,which base on "understanding" to "is fit" for Librarians,HE understudies and graduates.

Since 1999, by 2011, the SCONUL model with seven focus data capacities has been used to spread the data and capacities of instructors and accountants among understudies. The fundamental improvement of this model is the extension of an electronic point of convergence in 2013 (SCONUL, 2013).

Perhaps than change the model to express understudy bundles like SCONUL central focuses, it is more brilliant to create an open model that can be used in the business and customers. Whether or not and how to do it depends upon the guardian. Want to change the model to the specific necessities of understudies.

SCONUL progressed central focuses portray the "understanding" of various thoughts and the "limit" of using, supervising, recognizing or making (for example) the capacities or instruments related with every segment.

The SCONUL electronic point of convergence describes the "understanding" and the usage of various thoughts, the "limit" of directing, perceiving or making (for example) the capacities or instruments of each segment.

THE SCONUL SEVEN PILLARS OF INFORMATION LITERACY
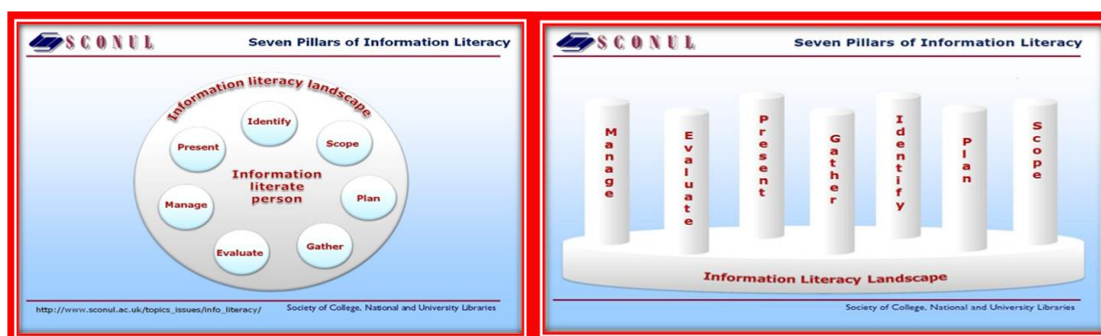
Identify : Researchers ability to distinguish a necessity for information

Scope: Can survey present data and see openings
Plan: Can collect framework to discover information and data
Gather: Can place and access the information and data they require
Evaluate: Can assess the investigation cycle , survey a great deal information and data
Manage: Can sort out information capacity and ethically
Present : Can apply the data obtained, present the results of their investigation and join current and outdated information and data to deliver new data and spread it in an alternate habits.

Lenses
A progression of "central focuses" is being made for various customer masses to work with the model to be used in unequivocal condition. Central focuses: Same Pillars, Different Views

All together for the model to be basic to specific client organizations and ages, the high level model is appeared as a nonexclusive "focus" model for Higher Education, to which a movement of "central focuses", tending to the various heaps of understudies, can be related.

SCONUL fostered a "point of convergence" particularly for understudies doing investigate in high level training. Despite the fact that the single words tending to the segments are something basically the same, their definition "fathoms" and "can" articulations change intangibly from those inside the middle model.

Research Lens in Seven Pillars

The Research Lens is the fundamental of the central focuses to be made. This point of convergence depicts limits and abilities (limit) and viewpoints and lead (understanding) which probably could be credited to investigate experts in UK Higher Education.

The Figures (I), (ii), (iii), (iv), (v), (vi), (vii) look at about each segment concerning their understandability and limit of the investigation practices in focus.

PILLAR: IDENTIFY	PILLAR: SCOPE
A researcher is able to recognize a need for information to concentrate on the research question	A researcher can assess their current knowledge and identify gaps
The researcher understands:	The researcher understands:
➢That novel data and information is continuously being fashioned and that there is forever more to learn	➢What types of information are available (e.g. data, people, written sources)
➢That being information literate involves developing a learning/research habit so new information is being actively sought all the time	➢The characteristics of different types of information source (e.g. books, journals, data banks) and how they may be affected by format (digital, print)
➢That ideas and opportunities are created by investigating/seeking information	➢The processes for the dissemination of research outputs, including publication, in terms of how and why individuals make their research results known and the currency of information
➢The scale of the world of published and unpublished information and data available	➢Issues of accessibility (e.g. free/subscribed; license restrictions, electronic/print)
➢That different disciplines place greater emphasis on different types of information and data.	➢What services are available to help and how to access them (eg different libraries, people, organizations, structures)
➢A researcher's need for information will vary depending on the task at hand, the subject discipline and the stage of research	The researcher is able to:
The researcher is able to:	➢"Know what you don't know" to identify any information gaps
➢Identify a lack of knowledge in a subject area	➢Identify which types of information (e.g. data, people, videos, published information) will best meet the need
➢Identify a research topic / question and define it using simple terminology	➢Identify the available search tools, such as general and subject specific resources at different levels
➢Articulate current knowledge on a topic	➢Identify different data collection methods
➢Recognize a need for information and data to achieve a specific end and define limits to the information need	➢Identify different formats in which information may be provided (e.g. print, digital, multimedia)
➢Use background information to underpin the search	➢Demonstrate the ability to use new tools as they become available
➢Take personal responsibility for a research project	
➢Manage own time effectively to complete a research project	

Fig (i): Pillar Identify   **Fig (ii): Pillar Scope**

PILLAR: PLAN

A researcher can construct strategies for locating information and data

The researcher understands:
- The range of searching techniques available for finding information. (e.g. discussing with peers, qualitative and quantitative research, browsing, data mining, active searching, serendipity)
- The differences between search tools (e.g. bibliographic databases, subject gateways, search engines) and the need to be familiar with a range of different retrieval tools, recognizing advantages and limitations
- Why complex search strategies can make a difference to the breadth and depth of information found
- The need to develop approaches to searching such that new tools are sought for each new question (not relying always on most familiar resources)
- The need to match data collection techniques to the circumstances
- The need to revise keywords and adapt search strategies according to the resources available and / or results found
- The value of controlled vocabularies and taxonomies in searching

The researcher is able to:
- Scope the research question clearly and in appropriate language
- Define a search strategy by using appropriate keywords and concepts, defining and setting limits (e.g. date, location, type of information)
- Select the most appropriate search tools (people, search engines, databases etc.) and data collection techniques
- Identify controlled vocabularies and taxonomies to aid in searching
- Identify appropriate search techniques (e.g. from finding contents pages and indexes to complex data mining)
- Identify specialist search tools appropriate to each individual information need

Fig (iii): Pillar Plan

PILLAR: GATHER

A researcher can locate and access the information and data they need

The researcher understands:
- How information and data is organized, digitally and in print sources (e.g. libraries)
- How libraries acquire and provide access to resources (e.g. print, multimedia, digital) including issues of authentication
- How digital technologies are providing collaborative tools to create and share information
- The issues involved in collecting new data
- The different elements of a citation and how this describes an information resource
- The use of abstracts
- The need to keep up to date with new information
- The relevance of Open Access resources
- The risks involved in operating in virtual environments (e.g. digital communication, visibility, confidentiality)
- The importance of appraising and evaluating search results

The researcher is able to:
- Use a range of different retrieval tools and resources effectively (e.g. databases, digital resources, other libraries)
- Construct complex searches for use across a range digital and print resources:
- Translate the search strategy to work in different resources
- Redefine a search strategy based on previous result sets
- Sort and manipulate results sets
- Access full text information, both print and digital, read and download online material and data
- Use appropriate research techniques to collect new data
- Keep up to date with new information (e.g. email alerts, RSS feeds)
- Engage with their scholarly community via networking, virtual communities, email lists
- Use online and printed help and can find personal, expert help

Fig (iv): Pillar Gather

PILLAR: EVALUATE

A researcher can review the research process and compare and evaluate information and data

The researcher understands:
- The information and data landscape of their discipline and how their research fits in
- Issues of quality, accuracy, relevance, bias, reputation and credibility relating to information and data sources
- The importance of consistency in data collection
- How the outputs of research are evaluated and disseminated, including the peer review process, publication, other forms of dissemination and research assessment
- The relevance of citation and Bibliometrics to their research context

The researcher is able to:
- Distinguish between different information resources (e.g. web pages, scholarly, professional, trade & popular journals)
- Choose a range of materials on topics, using appropriate criteria
- Assess the quality, accuracy, relevance, bias, reputation and credibility of the information resources found
- Read critically, identifying key points and arguments
- Assess the credibility of the data gathered
- Relate the information found to the original search strategy and their own research and adapt the search strategy as appropriate
- Critically appraise and evaluate their own findings and those of others
- Use citation metrics as an evaluative technique (e.g. citation counting, journal impact factors, h-index)
- Edit/peer review the work of colleagues

Fig (v): Pillar Evaluate

PILLAR:MANAGE

A researcher can organize information professionally and ethically

The researcher understands:
- Their responsibility to act with professional integrity and to be honest in all aspects of research, especially information handling and dissemination (e.g. copyright, plagiarism and IP issues)
- The need to adopt appropriate data handling and curation methods
- The role they play in helping others in information seeking and management
- The need to keep systematic records, for example of: search strategies and resources searched; -resources found & resources used research data
- The importance of sharing research data ethically without breaching data protection and informed consent of individuals
- The relevance of Freedom of Information to research activities
- The need to curate and archive research data ethically
- The importance of metadata
- The role of professionals, such as data managers and librarians, who can advise, assist and support with all aspects of information management

The researcher is able to:
- Use appropriate bibliographical software to manage information
- Cite printed and electronic sources using suitable referencing styles
- Create appropriately formatted bibliographies
- Demonstrate awareness of issues relating to the rights of other researchers and research participants, including ethics, data protection, copyright, plagiarism and any other intellectual property issues
- Set and meet standards of conduct for academic integrity
- Identify data curation opportunities to ensure that research data is ethically stored for re-use in other projects
- Use appropriate data management software and techniques to manage and curate research data
- Make appropriate information available as required

Fig (vi): Pillar Manage

PILLAR:PRESENT

A researcher can apply the knowledge gained: presenting the results of their research, synthesizing new and old information and data to create new knowledge , disseminating it in a variety of ways

The researcher understands:
- The difference between summarizing and synthesizing
- That different forms of writing/ presentation style can be used to present information to different communities
- That data can be presented in different ways
- Their personal responsibility to share and curate information and data
- Their personal responsibility to disseminate information & knowledge to their subject community and the wider world
- How their research outputs will be peer reviewed, evaluated and disseminated
- The processes of publication and academic exploitation of research results
- The concept of attribution, especially in relation to citation and co authorship
- That researchers can take an active part in the creation of information through traditional publishing and digital technologies (e.g. blogs, wikis)

The researcher is able to:
- Use the information and data found to address the research question
- Summarize documents and reports verbally and in writing
- Analyse and present data appropriately
- Incorporate new research findings into the context of existing knowledge/ See connections between sections of own data and the literature
- Synthesize and appraise new and complex information from different sources
- Communicate effectively using appropriate writing styles in a variety of formats (e.g. abstract, literature review, scientific report, journal article, poster, conference paper, visually, Web 2.0)
- Communicate effectively verbally (e.g. conference presentation, seminar)
- Select appropriate publications and dissemination outlets in which to publish research findings and data
- Use open access as well as traditional publishing routes
- Develop a personal profile in the scholarly community using appropriate personal and digital technologies (e.g. discussion lists , social networking sites, blogs, etc.)

Fig (vii): Pillar Present

Graduate Employability (2015) Lens on the Sconul Seven Pillars of Information Literacy
This is the Graduate Employability Lens on the SCONUL Seven Pillars, composed by Stephane Goldstein. The point of convergence itself recognizes what the graduated class grasps and can do in all of the 7 segments (which are: Identify, Scope, Plan, Gather, Evaluate, Manage, Present).

The Figures (I), (ii), (iii), (iv), (v), (vi), (vii) look at about each segment concerning their understandability and limit of the graduated class relating to Employability.

Fig (i): Pillar Identify   **Fig (ii): Pillar Scope**

Fig (iii): Pillar Plan/Gather   **Fig (iv): Pillar Evaluate**

Fig (v): Pillar Manage   **Fig (vi): Pillar Present**

Sconul Digital Literacy Lens (2013)

SCONUL's working group on information literacy promotes IL within Higher Education sector by developing and refining 7 pillars model, supporting info professionals to deliver innovative IL, Providing a focus for IL within SCONUL and manage any IL-related development. A Digital literate should possess Learning skills, ICT/Computer Literacy, Information Literacy, Media Literacy, Communication and Collaboration.

The Figures (i), (ii), (iii), (iv), (v), (vi), (vii) discuss about each pillar with respect to their understandability and ability.

SCONUL DIGITAL LITERACY LENS

Identify

Understands

The concept of digital literacy within an educational setting

The Internet is not regulated but content may be structured and regulated in a variety of ways depending on the requirements of the provider **Technology** is constantly evolving and the exploration and evaluation of new and emerging information systems is a lifelong process

The lifecycle of digital content, including issues around provenance, sharing and long-term access and preservation **The benefits and limitations** of using different forms of digital content, tools and technologies to meet specific needs.

Is able to:

Recognize the importance of skills in locating, creating managing and sharing information through a variety of digital forms **Identify** gaps relating to the use, application or development of digital environments and tools **Continuously assess** how the use of digital content and tools could enhance academic practice **Recognize** where digital solutions can meet a specific information task or need

Fig (i): Pillar Identify

SCONUL DIGITAL LITERACY LENS

Scope

Understands

Issues around copyright, IPR and CC licenses in relation to the use and creation of digital material

The need to address issues of accessibility relating to digital content **The characteristic** of different digital publication formats, the functionality available within software platforms and the benefits and limitations of these in relation to the task

The impact of online collaboration and networking as a means of developing, exchanging and communicating information.

Is able to:

Identify gaps in knowledge relating to digital tools or content **Identify** search tools for locating quality digital material

Assess different digital formats and select those to meet current need

Use new tools and technologies as they become available and evaluate them for suitability

Assess how online collaboration can enhance academic practice

Fig (ii): Pillar Scope

SCONUL DIGITAL LITERACY LENS

Plan

Understands

How to search for digital content using appropriate tools and techniques

The differences between search tools (operating within and between environments), recognizing their benefits and limitations **The impact** of sharing digital content

How the use of different online communication tools can extend reach and enable teamwork and collaboration **Where to** locate and publish digital content for formal publication purposes and for information exchange purposes, appreciating the differences between the two.

Is able to:

Identify appropriate online search techniques **Remotely access** external digital sources in order to extend opportunities for discovery **Assess** which form(s) of digital media best meets the criteria identified

Use different online communication approaches to extend reach **Assign** meta-data tags to content to enable future discoverability

Fig (iii): Pillar Plan

SCONUL DIGITAL LITERACY LENS

Gather

Understands

The range of different forms of digital publication and media, the different audiences they are designed for and how they are organized **Issues around** the popularity of a resource versus its academic quality

How digital technologies are providing collaborative tools to create and share knowledge and the implications this has on gathering specific information. **The risks** of operating in a virtual world and how they can be mitigated

The importance of appraising and evaluating results of online searches.

Is able to:

Use a range of digital retrieval tools and technology effectively **Access**, read and download digital information and data **Engage in** online collaboration and networking to access and share information

Fig (iv): Pillar Gather

SCONUL DIGITAL LITERACY LENS

Evaluate

Understands

The need to make choices in the use of different technologies to meet specific needs

Issues of quality, accuracy, relevance, credibility, format and accessibility relating to digital information **How to assess** the profile and visibility of digitally published information using analytic functionality and tools

The need to be a critical user of digital technologies **The importance** of citation of digital resources in learning and research contexts.

Is able to:

Assess the suitability of digital content for the intended audience **Assess** the quality, accuracy, relevance, credibility, format and accessibility of digital material **Read** online information critically, taking into account access restrictions **Maximize** discoverability of own digital material using indexing strategies

Fig (v): Pillar Evaluate

SCONUL DIGITAL LITERACY LENS

Manage

Understands

The need to handle, store and disseminate digital information and data in a responsible and ethical way

Issues of plagiarism **The principles** of citing and referencing digital sources and formats to enable verification **The need** to keep systematic records of digital sources using relevant technology **How** technologies can be used to personalize individual and shared digital environments

How security profiles can be used to manage levels of interaction

Is able to:

Use appropriate tools to organize digital content and data (social bookmarking, bibliographic software) **Cite and** reference electronic sources appropriately **Manage** digital resources effectively taking account of version control, file storage and record keeping issues **Personalize** the digital environment according to need

Fig (vi): Pillar Manage

SCONUL DIGITAL LITERACY LENS

Present

Understands

The need to select a communication approach suitable for the audience

Issues around accessibility of digital information, formats and compatibility with accessibility software

The importance of online security and privacy **How to** communicate appropriately online

The need to consider the digital self and ones online presence

That new technologies allow for information in new ways (blogs, wikis, open access).

Is able to:

Communicate effectively in a digital environment, using appropriate tools, to meet audience needs, taking account of accessibility issues **Confidently use** the digital media appropriate for presentation **Develop** an online personal profile using appropriate networks and technologies **Stay** safe and, if necessary, private in the digital world **Select** appropriate publication and dissemination outlets to share information

Fig (vii): Pillar Present

OER LENS (Open Content / Open Educational Resources lens) (2013)

The OER LENS identifies the 7 pillars of (IL) information literacy on "open content" and "open educational resources".

The Figures (i), (ii), (iii), (iv), (v), (vi), (vii) discuss about each pillar with respect to their understandability and ability of OER user.

OER LENS (Open Content / Open Educational Resources lens)

Identify

Understands

Concept of openness' in relation to educational resources and practices

That new open content is constantly being produced

The benefits to be gained from creating, sharing and reusing content

Impact of local policy, infrastructure and support in creating a culture of sharing and openness

How to assess whether using open content or making your own content open will meet your needs

Is able to:

Recognize decision to make one's content open may involve others as well as self **Recognize** a need for new skills in locating, creating, reusing, sharing content and identify the skills gap **Assess** how open content could enhance the learner experience

Fig (i): Pillar Identify

OER LENS (Open Content / Open Educational Resources lens)

Scope

Understands

What material can and should be shared

The issues of IPR/copyright status and Creative Commons licenses in relation to reuse

The characteristics of different types of open content and how these may affect where they are published or aggregated

Who else must be involved in locating and/or developing content **Where specialist** services and support can be found

Is able to:

Identify material suitable for intended audience **Articulate** reasons for using and making content open **Assess** when content should not be made open

Identify platforms and search tools for locating good quality digital content

Fig (ii): Pillar Scope

OER LENS (Open Content / Open Educational Resources lens)

Plan
Understands
Where to locate and publish suitable content
How to search for content which is available for use/re- use **The differences** between different platforms where open content is located, recognizing advantages and limitations
Is able to:
Use external sources e.g. Jorum; YouTube etc to extend discovery **Identify appropriate** search techniques to use as necessary **Assign** rights to any new or remixed content

Fig (iii): Pillar Plan

OER LENS (Open Content / Open Educational Resources lens)

Gather
Understands
Where to locate content for share/re- use
The limitations of libraries in providing access to digital OER content
What makes content accessible
The importance of folksonomies in locating open content
The importance of source files e.g. SWF in enabling reuse/remixing of content
Is able to:
Apply metadata tags to add value to content **Organize** content into suitable chunks for learning **Deposit content** in repository or other suitable location(s)

Fig (iv): Pillar Gather

OER LENS (Open Content / Open Educational Resources lens)

Evaluate
Understands
Issues of quality, relevance, accessibility and format **How to assess impact and** discoverability of open content
Is able to:
Assess the suitability of the content for the intended audience **Determine** and articulate what prior knowledge of the subject is required of the audience **Maximize** discoverability of open content by other practitioners' and audiences of learners

Fig (v): Pillar Evaluate

OER LENS (Open Content / Open Educational Resources lens)

Manage
Understands
Principles of designing for reuse
The content lifecycle and the passage of time on digital content **Interoperability** and open standards for use and reuse **The importance** of timing of availability for maximum impact
Is able to:
Identify how text- based materials can be best transformed into digital formats **Manage** multiple versions and version control **Alter format** of content to meet audience needs **Recognize the need** to refresh or withdraw open content at the end of its lifecycle

Fig (vi): Pillar Manage

OER LENS (Open Content / Open Educational Resources lens)

Present
Understands
The needs of the intended audience; their unique situated characteristics **Pedagogic approaches** to the structure, activity and context for delivery of open content **The audience** for open content is distributed and self- selecting
Is able to:
Design and apply open educational practices around open content in a taught context **Articulate the level of** personal engagement with a distributed, self-selected audience

Fig (vii): Pillar Present

EBP Lens (Evidence-based practice) in healthcare Lens:
Clinical consideration experts over medication, nursing and joined prosperity disciplines were encouraged to investigate their arrangement and care of the clinical information searching for cooperation and practices. This data was by then used to build an EBP point of union utilizing indisputable clinical consideration communicating and contemplations inside the center delineate. Accountants of Health Science can utilize this point of convergence as a system to instruct the plan and plan of data preparing programs for clinical staff. Advance data may too be gotten by assessing the impact and sensibility of the mark of union on data capacity levels and at a local level.
Conclusion

The middle model has accentuation on capacities, seen as straight, focused on print unbendable, dangerous to change, by heads for guardians; 12 years former so didn't cover novel thoughts and improvements inside the information world.

Hence, the progression of "Point of convergence" came basically as new model: with key guidelines (1) Must be versatile and flexible (2) Must rehash, not development driven (3) Able to apply to grouped customer individuals (4) Early primary center should be UK Higher Education (5) Core model necessities to utilize normal (guardian, academic) verbalizations (6) Must expand from "capacities" to "mindsets and practices". (6) Must be not hard to apply in practical conditions, accepting the fortitude to be kept „ by watching out for the weakness, by considering the setting of the special capacity you groups by picking an affirmation of part of a section where you are sure and could cultivate more, acquired the working social affair to progress through the above "Point of convergence". Finally in any case, the central focuses plan to help IL experts' assistance that there is framework and ability can be used when gone up against with a rapidly growing measure of assessment and a declining proportion of time.

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